Digitized by the Internet Archive
in 2024

https://archive.org/details/worksofjohnburro0000john_r4q9

Riverby Edition

THE WRITINGS OF JOHN BURROUGHS

WITH PORTRAITS AND MANY ILLUSTRATIONS

VOLUME XVII

B972w
v. 17

THE WRITINGS

OF

JOHN BURROUGHS

XVII

THE SUMMIT OF THE YEARS

BOSTON AND NEW YORK
HOUGHTON MIFFLIN COMPANY
The Riverside Press Cambridge

Copyright 1913
By John Burroughs
All rights reserved

PREFACE

IN publishing another volume of mixed essays, most of them written in the over-time I have made since I passed the Scriptural limit of threescore and ten years, I am cherishing the hope that my reader will not wish I had stopped at the boundary set by the Psalmist.

There is no other joy in life like mental and bodily activity, like keeping up a live interest in the world of thought and things. Old age is practically held at bay so long as one can keep the currents of his life moving. The vital currents, like mountain streams, tend to rejuvenate themselves as they flow.

One reaps his harvest, and it looks as if his acres would never yield another, but lo! as the seasons return, there springs a fresh crop of ideas and observations. It seems as if one never could get to the end of all the delightful things there are to know, and to observe, and to speculate about in the world. Nature is always young, and there is no greater felicity than to share in her youth. I still find each day too short for all the thoughts I want to think, all the walks I want to take, all the books I want to read, and all the friends I want to see. But I will confide to my reader that there is one thing I am quite cer-

tain I have got to the end of, and that is the vexed question of the animal mind. Whether the dog, the cat, and the cockroach reason or not, shall trouble me (and them) no more. While I write these lines in my outdoor study, a chipmunk whose den is near by, comes in and eagerly selects the hard, dry kernels of pop-corn from the soft unripe kernels of sweet corn which I have sprinkled upon the floor at my feet, stuffs his cheek pockets with them and hurries away to his den as if he knew that the dry corn would keep in his retreat, and that the green would not. After he has collected all the dry kernels, he falls to eating the green ones. I also sprinkle choke-cherries among the corn. These he finally proceeds to strip of their pulp and skins, and stuff his pockets with their pits, and rushes off to his den — thus putting no perishable food in his winter retreat. Does the pretty little rodent reason about all this? Ah! my reader, ask some one else! As for me, I will content myself with his companionship as he runs along my study table, pokes his nose into the arch made by my hand, under which the kernels lie, and even climbs to the crown of my head. He sets me to thinking, and I, if I do not set him to thinking, at least aid him in adding to his winter supplies. We are both learning something; day unto day uttereth knowledge, and even a chipmunk shares a little of the wisdom that pervades the universe.

CONTENTS

I. The Summit of the Years 1

II. In "the Circuit of the Summer Hills" 24

III. In the Noon of Science 48

IV. The Hit-and-Miss Method of Nature . 76

V. A Barn-Door Outlook 93

VI. The Animal Mind 113

VII. Nature and Animal Life 138

VIII. The Key to Animal Behavior . . . 155

IX. The Animal and the Puzzle-Box . . 175

X. Untaught Wisdom 201

XI. The Bow in the Clouds 212

XII. The Round World 217

XIII. A Hay-Barn Idyl 223

XIV. In Field and Wood 236

I. intensive observation 236

II. from a walker's wallet . . . 246

III. men and animals 256

CONTENTS

IV. BIRD-NESTING TIME 267

V. WEASEL AND RABBIT 274

VI. WILD LIFE IN WINTER 281

VII. A FEATHERED BANDIT 288

INDEX 293

ILLUSTRATIONS

John Burroughs at Woodchuck Lodge (p. 24) *Frontispiece*

The Schoolhouse, near Woodchuck Lodge, where Mr. Burroughs and Jay Gould went to School 26

John Burroughs at his Desk in the Barn at Woodchuck Lodge 94

Riverby, Mr. Burroughs's House on the Hudson River 178

The Study at Riverby 250

From photographs taken in 1912 by Charles S. Olcott.

I

THE SUMMIT OF THE YEARS

I

THE longer I live the more my mind dwells upon the beauty and the wonder of the world. I hardly know which feeling leads, wonderment or admiration. After a man has passed the psalmist's dead line of seventy years, as Dr. Holmes called it, if he is of a certain temperament, he becomes more and more detached from the noise and turmoil of the times in which he lives. The passing hubbub in the street attracts him less and less; more and more he turns to the permanent, the fundamental, the everlasting. More and more is he impressed with life and nature in themselves, and the beauty and the grandeur of the voyage we are making on this planet. The burning questions and issues of the hour are for the new generations, in whom life also burns intensely.

My life has always been more or less detached from the life about me. I have not been a hermit, but my temperament and love of solitude, and a certain constitutional timidity and shrinking from all kinds of strife, have kept me in the by-paths rather than on the great highways of life. My talent,

such as it is, is distinctly a by-path talent, or at most, a talent for green lanes and sequestered roadsides; but that which has most interested me in life, nature, can be seen from lanes and by-paths better even than from the turnpike, where the dust and noise and the fast driving obscure the view or distract the attention. I have loved the feel of the grass under my feet, and the sound of the running streams by my side. The hum of the wind in the tree-tops has always been good music to me, and the face of the fields has often comforted me more than the faces of men.

I am in love with this world; by my constitution I have nestled lovingly in it. It has been home. It has been my point of outlook into the universe. I have not bruised myself against it, nor tried to use it ignobly. I have tilled its soil, I have gathered its harvests, I have waited upon its seasons, and always have I reaped what I have sown. While I delved I did not lose sight of the sky overhead. While I gathered its bread and meat for my body, I did not neglect to gather its bread and meat for my soul. I have climbed its mountains, roamed its forests, sailed its waters, crossed its deserts, felt the sting of its frosts, the oppression of its heats, the drench of its rains, the fury of its winds, and always have beauty and joy waited upon my goings and comings.

I have kept apart from the strife and fever of the

world, and the maelstrom of business and political life, and have sought the paths by the still waters, and in the quiet fields, and life has been sweet and wholesome to me. In my tranquil seclusion I am often on the point of upbraiding myself because I keep so aloof from the struggles and contentions and acrimonious debates of the political, the social, and the industrial world about me. I do not join any of the noisy processions, I do not howl with the reformers, or cry Fire! with the alarmists. I say to myself, What is all this noisy civilization and all this rattling machinery of government for, but that men may all have just the sane and contented life that I am living, and on the same terms that I do. They can find it in the next field, beyond the next hill, in the town or in the country — a land of peace and plenty, if one has peace in his heart and the spirit of fair play in his blood.

Business, politics, government, are but the scaffoldings of our house of life; they are there that I may have a good roof over my head, and a warm and safe outlook into the beauty and glory of the universe, and let them not absorb more time and energy than the home itself. They have absorbed very little of mine, and I fancy that my house of life would have had just as staunch walls, and just as many windows and doors, had they not absorbed so much of other men's. Let those who love turmoil arm for turmoil: their very arming will bring it;

and let those who love peace disarm for peace: the disarming will hasten it.

I know that all this clamor and competition, all this heat and friction and turmoil of the world, are only the result of the fury with which we play the game of our civilization. It is like our college football, which is brutal and killing, and more like war than like sport. Why should I be more than an amused or a pained spectator?

I was never a fighter; I fear that at times I may have been a shirker, but I have shirked one thing or one duty that I might the more heartily give myself to another. He also serves who sometimes runs away.

From the summit of the years I look back over my life, and see what I have escaped and what I have missed, as a traveler might look back over his course from a mountain-top, and see where he had escaped a jungle or a wilderness or a desert, and where he had missed a fair field or a fountain, or pleasant habitations. I have escaped the soul-killing and body-wrecking occupations that are the fate of so many men in my time. I have escaped the greed of wealth, the "mania of owning things," as Whitman called it. I have escaped the disappointment of political ambition, of business ambition, of social ambition; I have never lost myself in the procession of parties, or trained with any sect or clique. I have been fortunate in being allowed to go

my own way in the world. I was fortunate in my youth in having escaped the daily paper, and especially the Sunday paper and the comic supplement, and the flood of cheap fiction that now submerges the reading public.

It is a question whether in escaping a college education I made a hit or a miss. I am inclined to the opinion that a little systematic training, especially in science, would have been a gain, though the systematic grind in literature which the college puts its students through I am glad to have escaped. I thank Heaven that in literature I have never had to dissect Shakespeare or Milton, or any other great poet, in the classroom, and that I have never had to dissect any animal in the laboratory. I have had the poets in their beautiful and stimulating unity and wholeness, and I have had the animals in the fields and woods in the joy of their natural activities. In my literary career I have escaped trying to write for the public or for editors; I have written for myself. I have not asked, "What does the public want?" I have only asked, "What do I want to say? What is there in my heart craving for expression? What have I lived or felt or thought that is my own, and has its root in my inmost being?"

I have few of the aptitudes of the scholar, and fewer yet of the methodical habits and industry of the man of business. I live in books a certain part of each day, but less as a student of books than as a

student of life. I go to books and to nature as a bee goes to the flower, for a nectar that I can make into my own honey. My memory for the facts and the arguments of books is poor, but my absorptive power is great. What I meet in life, in my walks, or in my travels, which is akin to me, or in the line of my interest and sympathies, that sticks to me like a burr, or, better than that, like the food I eat. So with books: what I get from them I do not carry in my memory, but it is absorbed as the air I breathe or the water I drink. It is rarely ready on my tongue or my pen, but makes itself felt in a much more subtle and indirect way.

There is no one, I suppose, who does not miss some good fortune in his life. We all miss congenial people, people who are going our way, and whose companionship would make life sweeter for us. Often we are a day too early, or a day too late, at the point where our paths cross. How many such congenial souls we miss we know not, but for my part, considering the number I have met, I think it may be many.

I have missed certain domestic good fortunes, such as a family of many children (I have only one), which might have made the struggle of life harder, but which would surely have brought its compensations. Those lives are, indeed, narrow and confined which are not blessed with several children. Every branch the tree puts out lays it open more to the

storms and tempests of life; it lays it open also to the light and the sunshine, and to the singing and the mating birds. A childless life is a tree without branches, a house without windows.

I missed being a soldier in the armies of the Union during the Civil War, which was probably the greatest miss of my life. I think I had in me many of the qualities that go to the making of a good soldier — love of adventure, keenness of eye and ear, love of camp-life, ability to shift for myself, skill with the gun, and a sound constitution. But the rigidity of the military system, the iron rules, the mechanical unity and precision, the loss of the one in the many — all would have galled me terribly, though better men than I willingly, joyously, made themselves a part of the great military machine. I should have made a good scout and skirmisher, but a poor fighter in the ranks. I am a poor fighter, anyhow.

My grandfather was a soldier of the Revolution, and he seems to have used up about all the fighting blood there was in the family, for little of it has shown itself since. When one of his sons was drafted in the War of 1812, he went in his stead, but did not get face to face with the enemy.

I got near enough to the firing line during our Civil War — when Early made his demonstration against the Capital in 1864, and I was a clerk in the Treasury Department — to know that I much prefer the singing of the birds to the singing of

hostile bullets. Maybe it was a nudge from the Old Continental within me that prompted me to make my way out Seventh Street, flanking and eluding the guards and sentinels of the Sixth Corps just up from Petersburg, taking a roundabout course through fields and woods, till just before dark I found myself amid the rifle-pits in front of one of the forts, fraternizing with the war-worn veterans who had been hurried up from Grant's army.

I had really made myself believe that if there was to be a battle I would have a hand in it and see what it was like. I was unarmed, but the soldiers assured me that they could quickly put a gun in my hand when the enemy appeared. There was some firing in front on a hill a mile away, and now and then I heard the *ping* of a rifle bullet overhead, and a few times the *thud* it makes when it strikes the ground. They were ugly sounds to me, and to the amusement of Grant's veterans who lay about on the ground, as if they were on a picnic, I presently took to the shelter of the rifle-pits and remained there. Later, when I saw a company of soldiers being hurried off into the darkness toward the line of rifle-flashes along the horizon in front, I had a sudden and vivid conviction that the stuff of a good soldier was not in me, — not at that moment, at any rate.

If I had been ordered to join those soldiers and face that unseen and unknown danger out there in

the night, I am sure my legs would have refused to move, and would have collapsed beneath me. What a coward I was at that instant! The Old Continental would have disowned me. But darkness makes cowards of us all. I suppose my imagination ran away with me as it so often had done in my boyhood in regard to "spooks" and hobgoblins.

As the night wore on and no attack on our line seemed imminent, I wandered toward the rear in search of new adventure. Passing a long, low building that was being used as a hospital, where the wounded were being cared for, I went in and offered my services to the surgeons. The operating-tables were full and a long line of the wounded sat crouched against the wall waiting their turns. Some were groaning and some were joking.

The sight of human blood had always made me faint, but now I seemed unusually stout of heart and proceeded to hold instruments and pass vessels with a coolness that quite surprised me. By force of will I must have steeled myself against the gory spectacle, for after about half an hour my composure broke. I grew suddenly faint and came near falling to the floor. The surgeon whom I was assisting, seeing at a glance what had happened to me, said, "Get out of here, get out of here!" and almost shoved me into the open air.

The air presently restored me, but I had had enough of war, and went and crept in among some

bales of hay near by and tried to sleep away the remainder of the night. But sleep did not come. All night I heard the clattering of hoofs and sabres as regiments of arriving cavalry filed slowly by me. In the morning I made my way back to the city, satisfied that military glory was not in the line of my ambition.

War is a terrible business, but I never see a veteran of our Civil War that I do not envy him that experience — an experience which maybe I should have had, had not grandfather so nearly emptied the family powder-horn in his soldiering with Washington.

II

From youth to age I have lived with nature more than with men. In youth I saw nature as a standing invitation to come forth and give play to myself; the streams were for fishing and swimming, the woods were for hunting and exploring, and for all kinds of sylvan adventure; the fields were for berries and birds' nests, and color, and the delight of the world of grasses; the mountains were for climbing and the prospects and the triumphs of their summits.

The world was good; it tasted good, it delighted all my senses. The seasons came and went, each with its own charms and enticements. I was ready for each and contented with each. The spring was for the delights of sugar-making, and the returning

birds — the naked maple woods flooded with the warm, creative sunshine, the brown fields slipping off their covering of snow, the loosened rills, the first robin, the first phœbe, the first song sparrow — how all these things thrilled one! The summer was for bare feet, light clothes, freedom from school, strawberries, trout, haymaking, and the Fourth of July. Autumn was for apples, nuts, wild pigeons, gray squirrels, and the great dreamy tranquil days; winter for the fireside, school, games, coasting, and the tonic of frost and snow. How the stars twinkled in winter! how the ice sang and whooped on the ponds! how the snow sculpturing decked all the farm fences! how the sheeted winds stalked across the hills!

Oh, the eagerness and freshness of youth! How the boy enjoys his food, his sleep, his sports, his companions, his truant days! His life is an adventure, he is widening his outlook, he is extending his dominion, he is conquering his kingdom. How cheap are his pleasures, how ready his enthusiasms! In boyhood I have had more delight on a haymow with two companions and a big dog — delight that came nearer intoxication — than I have ever had in all the subsequent holidays of my life. When youth goes, much goes with it. When manhood comes, much comes with it. We exchange a world of delightful sensations and impressions for a world of duties and studies and meditations. The youth

enjoys what the man tries to understand. Lucky is he who can get his grapes to market and keep the bloom upon them, who can carry some of the freshness and eagerness and simplicity of youth into his later years, who can have a boy's heart below a man's head.

The birds have always meant much to me; as a farmboy they were like a golden thread that knit the seasons together. In early manhood I turned to them with the fondness of youth, reinforced with an impetus obtained from literature. Books, especially the poets, may do this for a man; they may consecrate a subject, give it the atmosphere of the ideal, and lift it up in the field of universal interest. They seem to have done something like that for me in relation to birds. I did not go to books for my knowledge of the birds, except for some technical knowledge, but I think literature helped to endow them with a human interest to me, and relate them to the deeper and purer currents of my life. What joy they have brought me! How they have given me wings to escape the tedious and the deadening! I have not studied them so much as I have loved them; at least, my studies have been inspired by love.

How much more easily and surely knowledge comes through sympathy than through the knowing faculties! It is as if I had imbibed my knowledge of the birds through the pores of my skin, through

the air I have breathed, through the soles of my feet, through the twinkle of the leaves, and the glint of the waters. I have gone a-fishing, and read their secrets out of the corners of my eyes. I have lounged under a tree, and the book of their lives has been opened to me. I have hoed in my garden, and read the histories they write in the air. Studied the birds? No, I have played with them, camped with them, gone berrying with them, summered and wintered with them, and my knowledge of them has filtered into my mind almost unconsciously.

The bird as a piece of living nature is what interests me, having vital relations to all out-of-doors, and capable of linking my mind to itself and its surroundings with threads of delightful associations. The live bird is a fellow passenger; we are making the voyage together, and there is a sympathy between us that quickly leads to knowledge. If I looked upon it as something to be measured and weighed and tabulated, or as a subject for laboratory experimentation, my ornithology would turn to ashes in my hands.

The whole of nature, directly or indirectly, goes with him who gives his mind to objects in the open air. The observer of bird-life in the open has heaven and earth thrown in. Well, I need not harp on this string. All lovers of life in the open know what I would say. The book of living nature is unlike other books in this respect: one can read it over and

over, and always find new passages and new meanings. It is a book that goes to press new every night, and comes forth fresh every morning, and yet it is not like the newspaper, except that it is up-to-date. Its news is always vital, you see it in the making, and you are not blinded or deafened with the dust and noise of the vulgar newspaper world.

III

I began by saying how much the beauty and wonder of the world occupies me these later years. How these things come home to me as life draws near the end! I am like a man who makes a voyage and falls so much in love with the ship and the sea that he thinks of little else and is not curious about the new lands before him. I suppose if my mind had dwelt much upon the other world toward which we are headed, and which is the main concern with so many passengers, I should have found less to absorb and instruct me in this. In fact, the hypothetical other world has scarcely occupied me at all, and when it has, I have thought of it as a projection from this, a kind of Brocken shadow cast by our love of life upon futurity. My whole being is so well, so exquisitely, attuned to this world, that I have instinctively felt that it was for this world that I was made.

I have never been able to see how I could be adjusted to two worlds unless they were much

alike. A better world I have never wanted. I could not begin to exhaust the knowledge and the delights of this one. I have found in it deep beneath deep, worlds within a world — an endless series of beautiful and wonderful forms forever flowing out of itself. From the highest heavens of the telescope to the minutest organisms of the miscroscope, all is beautiful and wonderful, and passeth understanding.

Oh, how much the world holds that it would be a joy to know! How wonderful my own origin, running back through the geologic ages to the first pulse of life in the primordial seas, and embracing all between that eternity and this moment! I love to dwell upon it, and to try to picture to myself the long road I have traveled, the forms of lowly life in which I have tarried, the vicissitudes I have lived through, the contingencies upon which my well-being has hung.

How wonderful that all these countless ages are beneath my feet, in the soil I tread upon and out of which I sprang!

The thought that I or my race had been arbitrarily placed here, and that I was not the inevitable outcome of the visible and invisible system of things, would not move me. I like to think I am not an interloper, or an accident in the universe, and that the whole of the unthinkable past has contributed to you and me. I will not say, is summed up in you and me, except in the sense that the highest results

of evolution culminate in us. There have been other lines of evolution than ours, and it would take all the forms of life on the globe to sum up the past.

How wonderful that the globe itself should have been born out of the nebular mist — the cosmic world-stuff in the womb of the great sidereal mother; that it should have had its fiery and turbulent youth; that it should have sobered and ripened with age; that its mantle of fertile soil should have been wrought out of the crude igneous and stratified rocks; that it falls forever around the sun, and never falls into it; that it is so huge that we cannot span it, even in imagination, but can picture it to ourselves only by piecemeal, as with a globe of our own making; and yet that it is only as a globule of blood in the veins of the Infinite; that it is moving with such incredible speed, and yet to our senses seems forever at rest; that the heavens are always above us wherever we are upon its surface, and never under us, as the image of a globe might lead us to infer would be the case at times — all this, I say, and more, fills me with perpetual wonder.

More and more I think of the globe as a whole, though I can only do so by figuring it to myself as I see it upon the map, or as a larger moon. My mind's eye cannot follow the sweep of its curve and take in more than a small arc at a time. More and more I think of it as a huge organism pulsing with life, real and potential.

When I come from the vast to the minute, I find equal cause for wonder and admiration. If I look at the body of a fly with my pocket-glass, or at the speck of an insect that crawls upon the page of my book as I read, I marvel at its exquisite structure and delicate adjustment of parts, the elaboration, the complexity, the ingenuity, the strange mechanism of it all. When I crush it, I feel what a consummation of creative workmanship, what a delicate and exquisite product of the long ages of evolution, I have brought to naught. When I see the marvelous intelligence of ants and bees with their communities and coöperations and complex economies, I cannot help but wonder what might have been the result had evolution continued on the same line, and mounted step by step, as it has in the vertebrates. Would some being with more intellect than man has, have been the result? Maybe it was so on Mars, or on some other world in the depths of space.

It is hard for us to conceive of mental gifts differing in kind from our own, but it is certain that the wisdom that the insect world possesses is not like our own, and comes to it in a way we know not of. The ants and bees do things that seem to imply what we call second sight, or a gift akin to clairvoyance. Take the case of one of the solitary wasps of which Sir John Lubbock tells us. When this wasp lays an egg, she acts as if she knew whether the egg would produce a male or a female; she puts five

insects by the male egg, and ten by the female, because the female needs twice as much food as the male. There are many cases like that, of seeing behind the veil of things in the insect world, and one can but marvel at it. It sometimes seems as if human beings possessed this gift in a tentative, rudimentary kind of way.

How can any one help but marvel when he considers the structure of his own body? — several millions or billions of minute cells, working together like little people to build it up and maintain it, dividing themselves into communities or fraternities each with its own work to do, and, so far as we can see, with none having the direction of the whole work — no head or superintendent or architect to determine what the finished structure shall be. One community of cells builds muscle, one nerves, another bones, another hair, skin, and nails, others the viscera, the brain, and so on, till the full stature of man is reached. No single cell or group of cells knows the plan or the end to which they are all working. What puts the result of all these myriad workmen together and makes the man? They are many, he is one. The microscope reveals them; it cannot reveal him. He rises from the world of minute plastic interacting forms as Venus rose from the sea, and the sea knows not the secret.

The great king said, "I am the state"; but think of the multiplex lives of all of his subjects that made

up and sustained the state, and that went on from day to day and from year to year entirely beyond his thought or ken! A man may say, "I am the body"; but the body is an aggregate of vital and chemical and mechanical forces that go their way without his leave or conscious knowledge. He can arrest them or destroy them, as the king can his subjects, but he cannot restore them or renew them. The forces that brought you and me here, and sustain us, how complex, how far-reaching, how impersonal and impartial, and how little subjected to our will!

When hostile germs from without invade a man's body, he is ill, he has a chill, a fever, an inflammation, but little he knows of the warfare — the struggles, the defeats, the deaths — that are going on in his tissues. Some of the lower forms have the power of regeneration, or of re-growing a lost part, — a tail, a section, a limb, — but man's body lost this power when it took on its highly organized nervous system with its huge complex brain.

In every living thing, it is cell wedded to cell, communities of cells wedded to communities, and all working on a plan unknown to any group of them. Yonder oak or pine started from a similar minute germ, and became a vast coöperative community, or series of coöperative communities, of associate cells, with no cell or community directing the whole.

The only analogue of these things I now think of in nature about us is afforded by a swarm of bees, wherein all the complex economies of the hive are carried on without a single or separate seat of authority in the hive. Maeterlinck aptly calls this invisible authority the "spirit of the hive" — a name for something that we know not of. So one may say, the spirit of the body, or the spirit of the tree, determines and controls all its complex economies, and makes of it a unit.

The cells that are the architects of one man's body cannot be distinguished from the cells that build another man's body, yet behold the difference between the two men — in size, disposition, brain-power! It looks as if there were something in the man that is not of his cells.

Indeed, the mystery of the cell has never been penetrated. A man, like every other animal, begins in a speck of nucleated protoplasm — so small that it seems to be almost at the vanishing point; yet in that microscopical entity there may slumber a Shakespeare, a Newton, a Darwin, a Lincoln, with all the complex inheritance of race and of family traits, and with all the wondrous individual endowments of mental powers.

That cell, invisible to the naked eye, is a world in itself. It divides and subdivides, and its progeny, apparently of their own motion, begin to organize the human body and to build it up, as I have said.

They resolve themselves into communities, or co-fraternities, each brotherhood with its own special work to do.

IV

How can one help marveling at the voyage we are making on this planet? One has to lift one's self up and use one's imagination to see that it is a voyage, and that our course lies through the star-paved abysses of infinite space. Few of us ever see it or realize it in all its awful grandeur. But sometimes, as we look up at the night sky, we are surprised out of our habitual stolidity and blindness; the mind opens for a moment, and we see the Infinite face to face; the veil is withdrawn, and the rays from myriads of orbs penetrate to the soul.

Oh, the worlds and systems of worlds that the night reveals, — the outlook off into infinity which the darkness brings! When the day is done, when the night falls, how are the heavens opened! how is the universe extended! how are the glory and the sublimity of creation multiplied! Out of the deep shadow of the earth what lights we behold! what rays penetrate to us from the farthermost depths of space! When the sun is gone, myriads of other suns are born. Without this negation called darkness how little we should suspect the awful grandeurs that compass us about! The day shuts us in, the sky is a roof that confines us; the night lets us

out into the great out-of-doors of the universe. We feel the infinite space, we confront the star-paved abyss; the constellations shock us out of our prose and humdrum; they reveal to us how wild and terrific and unfathomable is the sea over which we are voyaging.

What does not the imagination of man, the spirit of man owe to the night — the revelation or the apocalypse of the darkness? The night is spiritual; how it hides all things secular, how it blots out the common and the wearisome, how it stirs and stimulates our religious emotions, how it nourishes our sense of mystery, and of the profound! It adds the transcendental, the immeasurable, to our world. It uncovers the heavens; they have a new meaning when we have walked under them at night.

I would not forget the debt we owe to the day; life itself, and all that sustains it, light and warmth, cloud and sun, brought us here and keep us here. The gifts of the night are less tangible; the night does not come with fruit and flowers and bread and meat; it comes with stars and star-dust, with mystery and nirvana.

I am a creature of the day; I belong to the open, cheerful, optimistic day. Few of my habits or feelings are nocturnal. I am not a prowler, nor a burner of midnight oil, nor a lover of the spectral or the obscure. I bring all things to the test of the sunlight; my mind works best, and my faith is

strongest, when the day is waxing and not waning. Yet now I am in the mood to praise the night, the not-day, the great shadow which is a telescope through which we see the Infinite.

The night that rounds the day of life is surely near all septuagenarians; the shadows deepen around us. When the darkness falls, will the heavens indeed be unveiled — the unquenchable lights meet our gaze?

In every man's life we may read some lesson. What may be read in mine? If I myself see correctly, it is this: that one may have a happy and not altogether useless life on cheap and easy terms; that the essential things are always near at hand; that one's own door opens upon the wealth of heaven and earth; and that all things are ready to serve and cheer one. Life is a struggle, but not a warfare, it is a day's labor, but labor on God's earth, under the sun and stars with other laborers, where we may think and sing and rejoice as we work.

II

IN "THE CIRCUIT OF THE SUMMER HILLS"

I

TO sit on one's rustic porch, or at the door of one's tent, and see the bees working on the catnip or motherwort or clover, to see the cattle grazing leisurely in the fields or ruminating under the spreading trees, or the woodchucks creeping about the meadows and pastures, or the squirrels spinning along the fences, or the hawks describing great spirals against the sky; to hear no sound but the voice of birds, the caw of crows, the whistle of marmots, the chirp of crickets; to smell no odors but the odors of grassy fields, or blooming meadows, or falling rain; amid it all, to lift one's eyes to the flowing and restful mountain lines — this is to get a taste of the peace and comfort of the summer hills.

This boon is mine when I go to my little gray farmhouse on a broad hill-slope on the home farm in the Catskills. Especially is it mine when, to get still nearer nature and beyond the orbit of household sounds and interruptions, I retreat to the big hay-barn, and on an improvised table in front of the big open barn doors, looking out into the sunlit

fields where I hoed corn or made hay as a boy, I write this and other papers.

The peace of the hills is about me and upon me, and the leisure of the summer clouds, whose shadows I see slowly drifting across the face of the landscape, is mine. The dissonance and the turbulence and the stenches of cities — how far off they seem! the noise and the dust and the acrimony of politics — how completely the hum of the honey-bees and the twitter of swallows blot them all out!

In the circuit of the hills, the days take form and character as they do not in town, or in a country of low horizons. George Eliot says in one of her letters: "In the country the days have broad open spaces, and the very stillness seems to give a delightful roominess to the hours." This is especially true in a hilly and mountainous country, where the eye has a great depth of perspective opened to it. Take those extra brilliant days that we so often have in the autumn — what a vivid sense one gets of their splendor amid the hills! The deep, cradle-like valleys, and the long flowing mountain lines, make a fit receptacle for the day's beauty; they hold and accumulate it, as it were. I think of Emerson's line: —

> "Oh, tenderly the haughty day fills his blue urn with fire."

The valleys are vast blue urns that hold a generous portion of the lucid hours!

To feel to the full the peace of the hills, one must choose his hills, and see to it that they are gentle and restful in character. Abruptness, jagged lines, sharp angles, frowning precipices, while they may add an element of picturesqueness, interfere with the feeling of ease and restfulness that the peace of the hills implies. The eye is disturbed by a confusion of broken and abrupt lines as is the ear by a volume of discordant sounds. Long, undulating mountain lines, broad, cradle-like valleys, easy basking hill-slopes, as well as the absence of loud and discordant sounds, are a factor in the restfulness of any landscape.

My landscape is very old geologically, as old as the order of vertebrate animals, but young historically, having been settled only about one hundred and fifty years. The original forests still cover the tops of the mountains with a dark-green mantle, which comes well down upon their sides, where it is cut and torn and notched into by the upper fields of the valley farms.

I call my place Woodchuck Lodge, as I tell my friends, because we are beleagured by these rodents. There is a cordon of woodchuck-holes all around us. In the orchard, in the meadows, in the pastures, these whistling marmots have their dens. Here one might easily have woodchuck venison for dinner every day, yea, and for supper and breakfast, too, if one could acquire a taste for it. I tried to dine on

a woodchuck once when I was a boy, but never have felt inclined to repeat the experiment. If one were born in the woods and lived in the woods, maybe he could relish a woodchuck. Talk about being autochthonous, and savoring of the soil — try a woodchuck! The feeding habits of this animal are as cleanly as those of a sheep or a cow; clover, plantain, peas, beans, cucumbers, cabbages, apples — all sweet and succulent things — go to the making of his flabby body; yet he spends so much of his time in pickle in the ground that his flesh is rank with the earth flavor. He is not lean like a rabbit or a squirrel, nor so firm of muscle as a 'coon or a 'possum; he is little more than a skin filled with viscera. He is busy all summer storing up fat in his loose pouch of a body for fuel during his long winter sleep. This sleep appears to begin in late September, or after the first white frost. This year I saw my last specimen on the 28th of the month as he was running in great haste to his hole. Evidently he does not like the pinch of the cold. He is a fair-weather animal and is the epicure of the meadows and pastures. While the apples are still mellow on the ground, while the red thorn is still dropping its fruit, and the aftermath is still fresh in the meadows, my woodchucks turn their backs upon the world and retreat to their underground chambers for their six months' slumber. I know of no other hibernating animal that retires from the light of day so early in

the season. His active life stretches from the vernal equinox to the autumnal equinox, and that is about all. Half the year he is under ground, and at least half of each summer day. No wonder his flesh is rank with the earth flavor. He appears to live only to accumulate his winter store of fat. Apparently he comes out of his den in summer only to feed, and maybe occasionally to bask in the sunshine. He is never sportive or discursive like the birds and squirrels. Life is a very serious business with him, and he has reduced it to the lowest terms — eat, breed, and sleep. If woodchucks ever engage in any sort of play, like other wild creatures, I never have seen them, though I once had a tame young 'chuck that would play with the kitten.

The woodchuck probably sleeps more than half the time in summer; he economizes his precious fat. Only once have I seen his tracks on the snow. This was in late December; and, following them up, I found the woodchuck wandering about the meadow like one half demented. Something had evidently gone wrong with him. Apparently he had not succeeded in storing up his usual amount of fat. He showed little fight, and we picked him up by the tail, put him into the sleigh, and brought him home. A place under the barn floor was given to him, but he did not long survive. All the glory of the fall, the heyday of the 'coon and the squirrels, the woodchuck misses. No golden

October, no Indian summer for him; he has had his day.

Though the woodchuck's muscles are flabby, his heart is stout. The farm-dog can kill him, but he cannot make him show fear or dismay; he is game to the last. Twice I have seen him from my porch at Woodchuck Lodge put on so bold a front and become so aggressive, when surprised in the middle of a field by a big shepherd-dog, that the dog did not dare attack him, but circled about, seeking some unfair advantage, only to be met at every point with those threatening, grating teeth. The woodchuck was far from his hole, and he kept charging the dog and driving him nearer and nearer the stone wall, where his own safety lay. An observer inoculated with the idea of animal reason would have said that the tactics of the 'chuck were premeditated; but I am sure he was too much engrossed with the task of defending himself from the jaws of that dog to do any logical thinking or planning. It was only the fortune of battle that finally brought the hunter and the hunted near the hole of safety, when, seeing his chance, the woodchuck made a sudden, successful dash, too hurried, I fancy, even to whistle his usual note of defiance. In the other case, the dog was of a still more timid nature, and when the surprised woodchuck showed fight, he concluded that he had no business at all with that particular 'chuck, which actually chased him from the meadow. I can

still see the woodchuck's bristling, expanded tail as he drove fiercely after the fleeing dog, which, with a tail anything but threatening, escaped over the wall into the road.

I find that one may be the principal actor in a little comedy, and not see the humor of it at all at the time. I know the humor of a race I had with a 'chuck last summer in my orchard was quite lost upon me till it was over, when the 'chuck was in his hole, and I was back upon my porch recovering my wind. The 'chuck was a hundred yards or more from his den when I leaped over the fence from the road and surprised him. I pressed him so closely that he took refuge in an apple-tree. Instantly seeing his mistake, as the missile I hurled struck the tree, he sprang down and rushed for his hole, a hundred and fifty feet away. But I got there first. The 'chuck paused twenty feet to one side and regarded me intently, defiantly. We stood and glared at each other a few moments, while I recovered my breath. I wanted the scalp of that "varmint." I knew that he would make himself believe that I had planted my garden for his special benefit, and I wanted to anticipate that conclusion. I was weaponless. Twenty or more feet from me, on the opposite side from the 'chuck, I saw a stone that would answer my purpose. I calculated the chances; so did the woodchuck; I sprang for the stone and the 'chuck sprang for his hole, and was in it as my

hand touched the stone. He had won! As I sat on my porch, the recklessness and absurdity of a man more than threescore and ten running down a woodchuck came over me; and I have not yielded to such a temptation since.

II

Where cattle and woodchucks thrive, there thrive I. The pastoral is in my veins. Clover and timothy, daisies and buttercups indirectly colored my youthful life; and if the dairy cow did not rock my cradle, her products sustained the hand that did rock it. Hence I love this land of wide, open, grassy fields, of smooth, broad-backed hills, and of long, flowing mountain lines. The cow fits well into these scenes. It seems as if her broad, smooth muzzle and her sweeping tongue might have shaped the landscape; it is certainly her cropping that has brought about the hourglass form of so many of the red thorn trees, which give a unique feature to the fields. Her fragrant breath is upon the air, her hoof-prints are upon the highway; she may not yet have attained to wisdom, yet surely all her ways are ways of pleasantness and all her paths are paths of peace. Hence, when her ways and her paths coincide with mine, I thrive best. From Woodchuck Lodge I look out upon broad pastures, lands where dairy herds have grazed for a hundred years, never the same herd for many summers, but all of the same habits

and dispositions. They all scour the pastures in the same way, scattering, searching out every nook and corner, leaving no yard of ground unvisited, apparently hunting each day for the sweet morsel they missed the day before, disposing themselves in picturesque groups upon the hills; never massed, except under the shade-trees on hot days; slow-moving, making their paths here and there, lingering under the red thorn trees, where the fruit begins to drop in September; tossing their heads above the orchard wall, where the fragrance of ripening apples is on the air; in the autumn lying upon the cold, damp ground and ruminating contentedly, with no fear of our ills and pains before them; wading in the swamps, converging slowly toward the pasture-bars as milking-time draws nigh, with always some tardy, indifferent ones that the farm-dog has to hurry up; many-colored, — white, black, red, brown, — at times showing rare gentleness and affection toward one another, such as licking one another's heads or bodies, then spitefully butting or goring one another; occasionally one of them lifting up her head and sending her mellow voice over the hills like a horn, as if to give voice to a vague unrest, or invoking some far-off divinity to release the imprisoned Io — what a series of shifting rural pictures I thus have spread out before me! Such an atmosphere of peace and leisure over it all! The unhurrying and ruminating cattle make the days

long; they make the fields friendly, the hills eloquent, the shade-trees idyllic. I wake up to hear the farmer summoning them from the field in the dewy summer dawns, and I listen for his call to them on the tranquil afternoons. One season an especially musical voice did the evening calling — a trained voice from beyond the hills. What a pleasure it was as we swung in our hammocks under the apple-trees to hear the free, sonorous summons, and to see the response of the herd in many-colored lines converging down the slope to the barway!

When the meadows have gotten a new carpet of tender grass in September, and the cows are free to range in them, a new series of moving pictures greets the eye. The grazing forms have a finer setting now, and contentment and satisfaction are in every movement. How they sweep off the tender herbage, into what artistic groups they naturally fall, what pictures of peace and plenty they present! When they lie down to ruminate, Emerson's sentence comes to mind: "And the cattle lying on the ground seem to have great and tranquil thoughts." As a matter of fact, I suppose no more vacant mind could be found in the universe than that of the cow when she is reposing in a field chewing her cud. But she is the cause of tranquil if not of great thoughts in the lookers-on, and that is enough. Tranquillity attends her wherever she goes; it beams from her eyes, and lingers in her footsteps.

I sympathize with Whitman as he expressed himself in these lines: —

"I think I could turn and live with the animals, they are so placid and self-contain'd.
I stand and look at them, long and long.

"They do not sweat and whine about their condition,
They do not lie awake in the dark and weep for their sins,
They do not make me sick discussing their duty to God.
Not one is dissatisfied, not one is demented with the mania of owning things,
Not one kneels to another, nor to his kind that lived thousands of years ago,
Not one is respectable or happy over the whole earth."

III

If one has a bit of the farmer in him, it is a pleasure in the country to have a real farmer for a neighbor — a man whose heart is in his work, who is not longing for the town or the city, who improves his fields, who makes two spears of grass grow where none grew before, whose whole farm has an atmosphere of thrift and well-being. There are so many reluctant, half-hearted farmers in our Eastern States nowadays, so many who do only what they have to do in order to survive; who leave the paternal acres to run to weeds or brush; the paternal fences to fall into ruins; the paternal orchards untrimmed and unploughed; the paternal meadows unfertilized, while the fertilizer wastes in the barnyard; who get but one spear of grass where their

fathers or grandfathers got two or three; and whose plaint always is that farming does not pay. What is the matter with our rural population? Has all the good farming blood gone West, and do only the dregs of it remain?

It is the man who makes the farm, as truly as it is the man who makes any other business; it is the man behind the plough, as truly as it is the man behind the gun, that wins the battle. A half-heart never won a whole sheaf yet. The average farmer has deteriorated. He may know more, but he does less, than his father. He is like the second or third steeping of the tea. Did the original settlers and improvers of the farms, and the generations that followed them, leave all their virtue and grip in the soil? It is certainly true that in my section the last two generations have lived off the capital of labor and brains which their ancestors put into the land; only here and there has a man added anything, only here and there is a farmer who does not wish he had some other business. If such men had that other business, they would reap the same poor results. In the long run, you cannot reap where you have not sown, and the only seed you can sow, in any business that yields tenfold, is yourself — your own wit, your own industry. Unless you plant your heart with your corn, it will mostly go to suckers; unless you strike your own roots into the subsoil of your lands, it will not bear fruit in your character,

or in your bank account — all of which is simply saying that thin, leachy land will not bear good crops, and unless a man has the real farming stuff in him, his farm quickly shows it.

My neighbor makes smooth the way of the plough and of the mower. Last summer I saw him take enough stones and rocks from a three-acre field to build quite a fortress; and land whose slumbers had never been disturbed with the plough was soon knee-high with Hungarian grass. How one likes to see a permanent betterment of the land like that! — piles of renegade stone and rock. It is such things that make the country richer. If all New England and New York had had such drastic treatment years ago, the blight of discouraged farming never would have fallen upon them, and the prairie States would not have so far distanced the granite States. A granite soil should grow a better crop of men than the silt of lake or river-bottom, though it yields less corn to the acre.

The prairie makes a strong appeal to a man's indolence and cupidity; it is a place where he can sit at ease and let his team do most of his work. But I much doubt whether the Western farms ever will lay the strong hands upon their possessors that our more varied and picturesque Eastern farms lay. Every field in these farms has a character of its own, and the farms differ from one another as much as the people do. An Eastern farm is the place for

a home; the Western farm is the place to grow wheat, pork, and beef. Oh, the flat, featureless, monotonous, cornstalk-littered Middle West! how can the rural virtues of contentment and domesticity thrive there? There is no spot to make your nest except right out on the rim of the world; no spot for a walk or a picnic except in the featureless open of a thousand miles of black prairie — the roads black, straight lines of mud or dust through the landscape; the streams slow, indolent channels of muddy water; the woods, where there are woods, a dull assemblage of straight-trunked trees; the sky a brazen dome that shuts down upon you; there are no hills or mountains to lift it up. The prairie draws no strong distinct lines against the sky; the horizon is vague and baffling. Ah, my mountains are very old measured by the geologic calendar! Yet how foreign to our experience or ways of thinking it seems to speak of mountains as either old or young, as if birth and death applied to them also. But such is the fact: mountains have their day, which day is the geologist's day of millions of years. My mountains were being carved out of a great plateau by the elements while the prairies were still under the sea, and while most of the Rocky Mountains and the Alps and the Himalayas were gestating in the vast earth-womb. In point of age, these mountains beside the Catskills are like infants beside their great-grandfathers. Yet it is a singular con-

tradiction that in their outlines old mountains look young, and young mountains look old. The only youthful feature about young mountains is that they carry their heads very high, and the only old feature about old mountains is that they have a look of repose and calmness and peace. All the gauntness, leanness, angularity, and crumbling decrepitude are with the young mountains; all the smoothness, plumpness, graceful, flowing lines of youth are with the old mountains. Not till the rocks are clothed with soil made out of their own decay are outlines softened and life made possible. Youthful mountains like the Alps are battle-marked by the elements, and their proud heads are continually being laid low by frost, wind, and snow; they are scarred and broken by avalanches the season through. Old mountains, such as the Appalachian System, wear an armor of soil and verdure over their rounded forms on which the arrows of Time have little effect. The turbulent and noisy and stiff-necked period of youth is far behind them.

Hundreds of dairy-farms nestle in the laps of the Catskills; and their huge, grassy aprons, only a little wrinkled here and there, hold as many grazing herds. Woodchuck Lodge is well upon the knee of one of the ranges, and the fields we look upon are like green drapery lying in graceful curves and broad, smooth masses over huge extended limbs. Patches of maple forest here and there bend over

a rounded arm or shoulder, like a fur cape upon a woman. Here and there also huge, weather-worn boulders rest upon the ground, dropped there by the moving ice-sheet tens upon tens of thousands of years ago; and here and there are streaks of land completely covered with smaller rocks wedged and driven into the ground. It used to be told me in my youth that the devil's apron-string broke as he was carrying a load of these rocks overhead, and let the mass down upon the ground. The farmers seldom attempt to clear away these leavings of the devil.

IV

My interest in the birds is not as keen as it once was, but they are still an asset in my life. I must live where I can hear the crows caw, the robins sing, and the song-sparrow trill. If I can hear also the partridge drum, and the owl hoot, and the chipmunk cluck in the still days of autumn, so much the better. The crow is such a true countryman, so much at home everywhere, so thoroughly in possession of the land, going his way winter and summer in such noisy contentment and pride of possession, that I cannot leave him out. The bird I missed most in California was the crow. I missed his glistening coat in the fields, his ebony form and hearty call in the sky.

One advantage of sleeping out of doors, as we do

at Woodchuck Lodge, is that you hear the day ushered in by the birds. Toward autumn you hear the crows first, making proclamation in all directions that it is time to be up and doing, and that life is a good thing. There is not a bit of doubt or discouragement in their tones. They have enjoyed the night, and they have a stout heart for the day. They proclaim it as they fly over my porch at five o'clock in the morning; they call it from the orchard, they bandy the message back and forth in the neighboring fields; the air is streaked with cheery greetings and raucous salutations. Toward the end of August, or in early September, I witness with pleasure their huge mass meetings or annual congress on the pasture hills or in the borders of the woods. Before that time, you see them singly or in loose bands; but on some day in late summer, or in early autumn, you see the clans assemble as if for some rare festival and grand tribal discussion. A multitudinous cawing attracts your attention, when you look hillward and see a swarm of dusky forms circling in the air, their voices mingling in one dissonant wave of sound, while loose bands of other dusky forms come from all points of the compass to join them. Presently many hundred crows are assembled, alternately lighted upon the ground and silently walking about as if feeding, or circling in the air, cawing as if they would be heard in the next township. What they are doing or saying or settling, what it all means,

whether they meet by appointment in the human fashion, whether it is a jubilee, a parliament, or a convention, I confess I should like to know. But second thought tells me it is more likely the gregarious instinct asserting itself after the scatterings and separations of the summer. The time of the rookery is not far off, when the inclement season will find all the crows from a large section of the country massed at night in lonely tree-tops in some secluded wood.

These early noisy assemblages may be preliminary to the winter union of the tribe. What an engrossing affair it seems to be with the crows! how oblivious they appear to all else in the world! The world was made for crows, and what concerns them is alone important. The meeting adjourns, from time to time, from the fields to the woods, then back again, the Babel of voices waxing or waning according as they are on the wing or at rest. Sometimes they meet several days in succession and then disperse, going away in different directions and irregularly, singly or in pairs and bands, as men do on similar occasions. No doubt in these great reunions the crows experience some sort of feeling or emotion, though one would doubtless err in ascribing to them anything like human procedure. It is not a definite purpose, but a tribal instinct, that finds expression in their jubilees.

The crows seem to have a great deal of business besides getting a living. How social, how communi-

cative they are! what picnics they have in the fields and woods, how absolutely at home they are at all times and places! I see them from my window flying by, by twos or threes or more, on happy, holiday wings, sliding down the air, or diving and chasing one another, or walking about the fields, their coats glistening in the sun, the movement of their heads timing the movements of their feet — what an air of independence and respectability and well-being attends them always! The pedestrian crow! No more graceful walker ever trod the turf. How different his bearing from that of a game-bird, and from any of the falcon tribe! He never tries to hide like the former, never morose and sulky like the latter. He is gay and social and in possession of the land; the world is his and he knows it, and life is good.

I suppose that if his flesh were edible, like that of the gallinaceous birds, he would have many more enemies and his whole demeanor would be different. His complacent, self-satisfied air would vanish. He would not advertise his comings and goings so loudly. He would be less conspicuous in the landscape; his huge mass-meetings in September would be more silent and withdrawn. Well, then, he would not be the crow — the happy, devil-may-care creature as we now know him.

His little gayly dressed brother, the jay, does not tempt the sportsman any more than the crow does, but he tempts other creatures — the owl and squir-

rel, maybe the hawk. Hence his tribe is much less. His range is also more restricted, and his feeding habits much less miscellaneous. Only the woods and groves are his; the fields and rivers he knows not.

The crow is a noisy bird. All his tribe are noisy, but the noise probably has little psychic significance. The raven in Alaska appears to soliloquize most of the time. This talkativeness of the crow tribe is probably only a phase of crow life, and signifies no more and no less than other phases — their color, their cunning, the flick of their wings, and the like. The barnyard fowls are loquacious also, but probably their loquacity is not attended with much psychic activity.

In the mornings of early summer the out-of-door sleeper is more likely to be awakened by the song-birds. In June and early July they strike up about half-past three. "When it is light enough to see that all is well around you, it is light enough to sing," they carol. "Before the early worm is stirring, we will celebrate the coming of day." During the summer the song-sparrows have been the first to nudge me in the morning with their songs. One little sparrow in particular would perch on the telephone-wire above the roadside and go through his repertoire of five songs with great regularity and joyousness. He will long be associated in my mind with those early, fragrant, summer dawns. One of his five songs fell so easily into words that I had only

to call the attention of my friends to it to have them hear the words that I heard, "If, if, if you please, Mr. Durkee," — the last word a little prolonged, and with a rising inflection. Another was not quite so well expressed by these words: "Please, please, speak to me, sweetheart." The third one suggested this sentence: "Then, then, Fitzhugh says, yes, sir!" The fourth one was something like this: "If, if, if you seize her, do it quick." The fifth one baffled me to suggest by words. But in August his musical enthusiasm began to decline. His different songs lost their distinctiveness and emphasis. It was as if they had faded and become blurred with the progress of the season.

The little birds are insignificant and unobtrusive on the great background of nature, yet if one learns to distinguish them and to love them, their songs may become a sort of accompaniment to one's daily life. Last May, while I was much occupied in repairing and making habitable my old farmhouse, a solitary mourning ground-warbler, which one rarely sees or hears, came and tarried about the place for a week or ten days, singing most of each forenoon in the orchard and garden about the house, and giving to my occupation a touch of something rare and sylvan. He lent to the old apple-trees, which I had known as a boy, an interest that the boy knew not. Then he went away, whether on the arrival of his mate or not I do not know.

A butternut-tree stands across the road in front of Woodchuck Lodge. One season the red squirrels stored the butternuts in the wall of one of the upper rooms of the unoccupied house, to which they gained access through a hole in the siding. When we moved in, in the summer, the squirrels soon became uneasy, and one day one of them began removing the butternuts, not to some other granary or place of safety, but to the grass and dry leaves on the ground in the orchard. He was unwittingly planting them by the act of hiding them. The automatic character of much animal behavior, the extent to which their lives flow in fixed channels, was well seen in the behavior of this squirrel. His procedure in transferring the nuts from his den in the house to the ground in the orchard, a distance of probably one hundred feet, was as definite and regular as the movement of a piece of machinery. He would rush up and over the roof of the house with a nut in his mouth, by those sharp, spasmodic sallies so characteristic of the movements of the red squirrel, down the corner of the house to the ground by the same jerky movements, across some rubbish and open ground in the same manner, alert and cautious, up the corner of a small building ten feet high and eight long, over its roof, with arched tail and spread feet, snickering and jerking, down to the ground on the other side, dashing to the trunk of an apple-tree ten feet away, up it a few feet to make an observa-

tion, then down to the ground again, and out into the grass, where he would carefully hide his nut, and cover it with leaves. Then back to the house again he would go by precisely the same route and with precisely the same movements, and bring another nut. Day after day I saw him thus engaged till apparently all the nuts were removed. He probably did not know he was planting butternut-trees for other red squirrels, but that was what he was doing. The crows and jays carry away and plant acorns and chestnuts in the same way, thus often causing a pine forest to be succeeded by these trees.

The red squirrel is only an irregular storer of nuts in the autumn. In this respect he stands halfway between the chipmunk and the gray squirrel, one of which regularly lays up winter stores and the other none at all.[1]

How diverse are the ways of nature in reaching the same end! Both the chipmunk and the woodchuck lay up stores against the needs of winter, the latter in the shape of fat upon his own ribs, and the former in the shape of seeds and nuts in his den in the ground; and I fancy that one of them is no more conscious of what he is doing than the other. Animals do not take conscious thought of the future; it is as if something in their organization took thought for them. One November, seized with the

[1] The gray squirrel hides nuts under the leaves and grass but he lays up no winter stores.

cruel desire to go to the bottom of the question of the chipmunk's winter stores, I dug out one after he had got his house settled for the season. I found his den three feet below the surface of the ground — just beyond the frost-line — and containing nearly four quarts of various seeds, most of them the little black grains of wild buckwheat — two hundred and fifty thousand of them, I estimated — all cleaned of their husks as neatly as if done by some patent machinery.

How many perilous journeys along stone walls and through weedy tangles this store of seeds represented! One would say at least a thousand trips, beset by many dangers from hawks and cats and weasels and other enemies of the little rodent.

The chipmunk is provident; he is a wise housekeeper, but one can hardly envy him those three or four months of inaction in the pitchy darkness of his subterranean den. His mate is not with him, and evidently the oblivion of the hibernating sleep, like that of the woodchuck and of certain mice, is not his. The life of the red and gray squirrels, who are more or less active all winter, seems preferable. They lay up no stores and are no doubt often cold and hungry, but the light of day and the freedom of the snow and of the tree-tops are theirs. Abundant stores are a good thing for both man and beast, but action, adventure, struggle are better.

III

IN THE NOON OF SCIENCE

I

HOW surely the race is working away from the attitude of mind toward life and nature begotten by an age of faith, into an attitude of mind toward these things begotten by an age of science! However the loss and gain may finally foot up, the movement to which I refer seems as inevitable as fate; it is along the line of the mental evolution of the race, and it can be no more checked or thwarted than can the winds or the tides. The disturbance of our mental and spiritual equilibrium consequent upon the change is natural enough.

The culture of the race has so long been of a non-scientific character; we have so long looked upon nature in the twilight of our feelings, of our hopes and our fears, and our religious emotions, that the clear midday light of science shocks and repels us. Our mental eyesight has not yet got used to the noonday glare. Our anthropomorphic views of creation die hard, and when they are dead we feel orphaned. The consolations which science offers do not move our hearts. At first the scientific explanation of the universe seems to shut us into a narrower

and lower world. The heaven of the ideal seems suddenly clouded over, and we feel the oppression of the physical. The sacred mysteries vanish, and in their place we have difficult or unsolvable problems.

Physical science magnifies physical things. The universe of matter with its irrefragable laws looms upon our mental horizon larger than ever before, to some minds blotting out the very heavens. There are no more material things in the world than there always have been, and we are no more dependent upon them than has always been the case, but we are more intently and exclusively occupied with them, subduing them to our ever-growing physical and mental needs.

I am always inclined to defend physical science against the charge of materialism, and that it is the enemy of those who would live in the spirit; but when I do so I find I am unconsciously arguing with myself against the same half-defined imputation. I too at times feel the weary weight of the material universe as it presses upon us in a hundred ways in our mechanical and scientific age. I well understand what one of our women writers meant the other day when she spoke of the "blank wall of material things" to which modern science leads us. The feminine temperament — and the literary and artistic temperament generally — is quite likely, I think, to feel something like a blank wall shutting it in, in the results of modern physical sciences. We

feel it in Herbert Spencer and Ernest Haeckel, and now and then in such lambent spirits as Huxley and W. K. Clifford. Matter, and the laws of matter, and the irrefragable chain of cause and effect, press hard upon us.

We feel this oppression in the whole fabric of our civilization — a civilization which, with all its manifold privileges and advantages, is probably to a large class of people the most crushing and soul-killing the race has ever seen. It practically abolishes time and space, while it fills the land with noise and hurry. It arms us with the forces of earth, air, and water, while it weakens our hold upon the sources of personal power; it lengthens life while it curtails leisure; it multiplies our wants while it lessens our capacity for simple enjoyments; it opens up the heights and depths, while it makes the life of the masses shallow; it vastly increases the machinery of education, while it does so little for real culture. "Knowledge comes but wisdom lingers," because wisdom cannot or will not come by railroad, or automobile, or aeroplane, or be hurried up by telegraph or telephone. She is more likely to come on foot, or riding on an ass, or to be drawn in a one-horse shay, than to appear in any of our chariots of fire and thunder.

With the rise of the scientific habit of mind has come the decline in great creative literature and art. With the spread of education based upon scien-

tific principles, originality in mind and in character fades. Science tends to eliminate the local, the individual; it favors the general, the universal. It makes our minds and characters all alike; it unifies the nations, but it tames and, in a measure, denatures them. The more we live in the scientific spirit, the spirit of material knowledge, the farther we are from the spirit of true literature. The more we live upon the breath of the newspaper, the more will the mental and spiritual condition out of which come real literature and art be barred to us. The more we live in the hard, calculating business spirit, the farther are we from the spirit of the master productions; the more we surrender ourselves to the feverish haste and competition of the industrial spirit, the more the doors of the heaven of the great poems and works of art are closed to us.

Beyond a certain point in our culture, exact knowledge counts for so much less than sympathy, love, appreciation. We may know Shakespeare to an analysis of his last word or allusion, and yet miss Shakespeare entirely. We may know an animal in the light of all the many tests that laboratory experimentation throws upon it, and yet not really know it at all. We are not content to know what the animal knows naturally, we want to know what it knows unnaturally. We put it through a sort of inquisitorial torment in the laboratory, we starve it, we electrocute it, we freeze it, we burn it, we incar-

cerate it, we vivisect it, we press it on all sides and in all ways, to find out something about its habits or its mental processes that is usually not worth knowing.

Well, we can gain a lot of facts, such as they are, but we may lose our own souls. This spirit has invaded school and college. Our young people go to the woods with pencil and note-book in hand; they drive sharp bargains with every flower and bird and tree they meet; they want tangible assets that can be put down in black and white. Nature as a living joy, something to love, to live with, to brood over, is now, I fear, seldom thought of. It is only a mine to be worked and to be through with, a stream to be fished, a tree to be shaken, a field to be gleaned. With what desperate thoroughness the new men study the birds; and about all their studies yield is a mass of dry, unrelated facts.

In school and college our methods are more and more thorough and businesslike, more and more searching and systematic: we would go to the roots of the tree of knowledge, even if we find a dead tree on our hands. We fairly vivisect Shakespeare and Milton and Virgil. We study a dead language as if it were a fossil to be classified, and forget that the language has a live literature, which is the main concern. We study botany so hard that we miss the charm of the flower entirely; we pursue the bird with such a spirit of gain and exactitude that a

stuffed specimen in the museum would do as well. Biology in the college class means dissecting cats and rats and turtles and frogs; psychology means analogous experimental work in the laboratory. Well, we know a lot that our fathers did not know; our schools and colleges are turning out young men and women with more and more facts, but, so it often seems to me, with less and less manners, less and less reverence, less and less humility, less and less steadfastness of character.

In this age of science we have heaped up great intellectual riches of the pure scientific kind. Our mental coffers are fairly bursting with our stores of knowledge of material things. But what will it profit us if we gain the whole world and lose our own souls? Must our finer spiritual faculties, whence come our love, our reverence, our humility, and our appreciation of the beauty of the world, atrophy? "Where there is no vision, the people perish." Perish for want of a clear perception of the higher values of life. Where there is no vision, no intuitive perception of the great fundamental truths of the inner spiritual world, science will not save us. In such a case our civilization is like an engine running without a headlight. Spiritual truths are spiritually discerned, material and logical truths — all the truths of the objective world — are intellectually discerned. The latter give us the keys of power and the conquest of the earth, but the former alone can

save us — save us from the materialism of a scientific age.

The scientific temperament, unrelieved by a touch of the creative imagination, is undoubtedly too prone to deny the existence of everything beyond its ken. But science has its limitations, which its greatest exponents like Tyndall and Huxley are frank to acknowledge.

All questions that pertain to the world within us are beyond the reach of science. Science is the commerce of the intellect with the physical or objective world; the commerce of the soul with the subjective and invisible world is entirely beyond its sphere. The very word "soul" belongs to literature and religion, and not to science. Science has no use for such a word because it stands for something which transcends its categories. Professor Tyndall confessed himself utterly unable to find any logical connection between the molecular activities of the brain-substance and the phenomenon of consciousness.

In trying to deal with such a question, he says, we are on the boundary line of the intellect where the canons of science fail us. Science denies all influence of subjective phenomena over physical processes. In the absence of the empirical fact, science would be bound to deny that a man could raise his arm by an act of volition; only "the phenomena of matter and force come within our intellectual range."

There are questions of mind and there are questions of matter; philosophy deals with the former, science with the latter. The world of the unverifiable is the world of the soul, the world of the verifiable is the world of the senses. We have our spiritual being in the one and our physical being in the other, and science is utterly unable to bridge the gulf that separates them.

II

The physico-chemical explanation of life and of consciousness to which modern science seems more and more inclined, falls upon some minds like a shadow. In trying to explain life itself in terms of physics and chemistry, science is at the end of its tether.

The inorganic world may grind away like the great mill that it is, run by heat, gravity, chemical affinity, and the like, and we are not disturbed; but in the world of organic matter we strike a new principle, and in any interpretation of it in terms of mechanics and chemistry alone, we feel matter pressing in upon us like the four walls coming together. Why does one dislike the suggestion of machinery in relation to either our minds or our bodies? Why does the chemico-mechanical explanation of any living thing give one a chill like the touch of cold iron? Is it because we feel that though life may be inseparably connected with chemical and mechani-

cal principles, it is something more than chemistry and mechanics?

We are something more than machines, though every principle of mechanics be operative in our bodies. We are something more than bundles of instincts and reflexes and automatic adjustments, though all these things play a part in our lives. We are something more than mere animals, though we are assuredly of animal origin. The vital principle, even the psychic principle, may not be separable from matter, not even in thought, and yet it is not matter, because the matter with which it is identified behaves so differently from the matter with which it is not identified. Organic matter behaves so differently from inorganic, though subject to the same physical laws. A stone may rot or disintegrate, but it will never ferment, because fermentation is a process of life. There is no life without chemical reactions, and yet chemical reaction is not life; there is no life without what biologists call the colloid state, and yet the colloid state is not life. Life is confined to a certain scale of temperature — beyond a certain degree up and down the scale life disappears, and yet life is not heat or motion, or moisture or chemical affinity, though inseparable from these things.

The biological view of our animal origin is an uncongenial fact, and we may struggle against it, but we cannot escape it. Science has fixed this brand

upon us. "Brand," I say, but have we not always recognized our animality and known that the wolf and the tiger slumbered in us? We knew it through a figure of speech, now we know it as a concrete fact.

Carlyle turned his back upon Huxley on the streets of London because Huxley had taught that mankind had an ape-like ancestor. Why is such a thought uncongenial and repelling? No doubt it is so. There is no poetry or romance in it as there is in the Garden of Eden myth. If we could look *up* to our remote progenitors instead of *down*, if we could see them clothed in light and wisdom instead of clothed in hair and bestiality, how much more enticing and comforting the prospect would be! But we simply cannot; we must see them adown a long darkening and forbidding prospect, clothed in low animal forms and leading low animal lives — a prospect that grows more and more dim till it is lost in the abyss of geologic time.

Carlyle would have none of it! The Garden of Eden story had more beauty and dignity. That this "backward glance o'er traveled roads" repels us, is no concern of science. It repels us because we regard it from a higher and fairer estate. Go back there and look up: let the monkey see himself as man (if he were capable of it), and what would his emotions be? The prehistoric man, living in caves and clothed in skins, if we go no further back, is not

a cheering person to contemplate. And his hairy, low-browed forebears in Tertiary times — can we see ourselves in them? It makes a vast difference whether we see the past as poetry, or see it as science. In the Bible, and in Whitman, we see it as poetry, in Darwin we see it as science.

"Rise after rise bow the phantoms behind me." Here Whitman, through his own creative imagination, anticipates Darwin. Carlyle probably would have been moved by such a picture of his origin as Whitman gives. It would have touched his fervid *ego*. When Haeckel or Darwin gives us an account of man's origin, it is not of my origin, or your origin; the personal element is left out, the past is not linked with the present by a flash: in other words, we see it in the light of science, and not in the light of the poetic imagination. And the light of science in such matters is the light of the broad, all-revealing noonday. It is therefore in the nature of things that the scientific view of life in some of its aspects should repel us, when it comes too near us, when it touches us personally, especially when it comes between us and our religious beliefs and aspirations.

III

We are not to forget that physical science is of necessity occupied with the physical side of things. And what is there in nature or in life that has not its physical side? Exclusive occupation with this

side does not make the poet or the prophet or the artist or the philosopher; it makes the man of science. Such occupation, no doubt, tends to deaden our interest in the finer and higher spiritual and intellectual values. The physical side of things is not often the joyous and inspiring side. The physical side of life, the physical side of birth, of death, of sex love, the physical side of consciousness and of our mental processes, the physical or biological side of our animal origin, and so on, are not matters upon which we fondly or inspiringly dwell. The heart, which symbolizes so much to us, is only a muscle — a motor-muscle, as we may say — that acts under the influence of some physical stimulus like any other motor; the brain, which is the seat of thought and consciousness, is a mass of gray and white matter incased in the skull. Every emotion or aspiration, the highest as well as the lowest, has its physical or physiological equivalent in our own bodies.

In the light of physical science our bodies are mere machines, and every emotion of our souls is accounted for by molecular changes in the brain-substance. Life itself is explained in terms of chemico-mechanical principles. Physical science spoke in Huxley, and doubtless spoke accurately, when he said, "The soul stands related to the body as the bell of a clock to its works, and consciousness answers to the sound the bell gives out when struck." It is not a very comforting or inspiring comparison,

but it is what physical science sees in the fact. And it is this side of life alone that science can deal with. Of the major part of our lives — of all our subjective experiences, our religious and æsthetic emotions, in fact the whole world of the ideal and the supersensuous — nothing can be known or explained in terms of exact science or mathematics.

To our higher sensibilities science is brutal, unhuman, unimaginative. It reveals to us an impersonal, mechanical world, where our hopes, our fears, our affections, in short our anthropomorphism, had created a personal world. Science has no fervor, no color, no dreams, no illusions, no weakness, no affections, no antagonisms, no temperament; it is not puffed up, thinketh no evil, and goes its way though all our gods totter and fall as it passes.

Science gives cold and colorless names to things. We are emotional as well as intellectual beings, but science appeals, in the first instance, to our intellects and not to our emotions. Where our religious emotions see the hand of God, science sees the sequence of efficient causes; where we fear and tremble, science is curious and inquiring.

As emotional and spiritual beings we cannot live by science alone. We can build our houses, run our farms, sail our ships, by the facts and methods of science, but as social, moral, religious, æsthetic beings, we require what science cannot give us. Our inner subjective lives are beyond its sphere.

Without soul and sentiment we cannot have literature, art, music, religion, and all that gives the charm and meaning to life; and without reason and the scientific habit of mind we cannot have exact knowledge and the mastery over the physical forces upon which our civilization is based. We must transcend physical science to reach the spiritual and grasp the final mystery of life. To science there is no mystery, there is only the inexplicable; there is no spiritual, there are laws and processes; there is no inner, there is only the outer, world. To science Goethe's exclamation, "There is a universe within thee as well," or as Jesus put it before him, "The kingdom of heaven is within you," has no meaning, because it cannot weigh and measure and systematize this inner universe. Hence, I say, if we would know the world as it stands related to our souls, — to our emotional and æsthetic natures, — we must look to literature and art; if we would know it as it stands related to our religious instincts and aspirations, we must look to the great teachers and prophets, poets and mystics; but if we would know it as it is in and of itself, and as it stands related to our physical life and well-being, and to our reason, we must look to science.

Science and poetry go hand in hand in this respect at least — they transform and illuminate the common, the near at hand. They show us the divine underfoot. One brings to pass what the other

dreams. One brings home to our understanding what the other brings home to our emotions and æsthetic perceptions. The poets have always known there was nothing mean or commonplace; science shows this to be a fact. The poets and prophets have always known that the earth was our mother and the sun our father; science shows us how and why this is so. The poets know that beauty and mystery lurk everywhere, and they bring the fact home to our emotions, while science brings it home to our understanding. When Whitman says, "I am stuccoed with birds and quadrupeds all over," he makes a poetic or imaginative statement of Darwinism. We think science kills poetry, and it does when it kills the emotion which the poet awakens, but in many cases science awakens an emotion of its own. In astronomy, in geology, and often in chemistry, it awakens the emotion of the sublime. Poetry appeals to man, the emotional being; science appeals to him, the reasonable being. Science kills poetry when it moves the reason alone. The botanist with his pressed flower, and the collector with his skins, or his eggs and nests, are not objects the poet likes to contemplate. There are the æsthetic values of things and the scientific values. The interest of the poet is in the beauty of the flower, its human significance, and the like; that of the man of science in its structure and relations, etc.

There is one emotion of knowledge and one emo-

tion of ignorance; that of knowledge is often the emotion of joy and faith, that of ignorance is often the emotion of fear and superstition. It would be absurd to say that men of science experienced no emotion; only it is not the emotion of sentiment, it is not usually the emotion of awe or reverence. It is the joy of discovery, the intellectual delight in the solution of new problems. Evidently the great biologist like Darwin is thrilled by the discovery of a biological law as is the poet by his happy inspirations. Think you Darwin's conception of natural selection and the descent of man required no imagination? Darwin's mind had not atrophied; his desire to know had outgrown his desire to feel. There is the enjoyment of knowledge and there is the enjoyment of beauty.

Science rarely antagonizes poetry; it takes the other road. The world has got to a point, no doubt, where it sets a greater store by knowing than by feeling, by knowledge than by sentiment; hence poetry is in the decline. The pleasures of the understanding are more to us than the pleasures of the imagination.

Science has its mysteries, but they do not awaken our emotions; it has its revelation, but it does not touch our religious sentiments; it has its beauty, but it is not the beauty that so moves us in wild, free nature; rather is it the beauty of the constructed, the artificial, or the beauty of machinery.

Let us give physical science its due. We owe to it all the exact knowledge we have of the physical universe in which we are placed and our physical relations to it. All we know of the heavens above us, with their orbs and the cosmic processes going on there; all we know of the earth beneath our feet, its structure, its composition, its physical history, science has told us. All we know of the mechanism of our own bodies, their laws and functions, the physical relation of our minds to them, science has told us. All we know of our own origin, our animal descent, science has revealed. The whole material fabric of our civilization we owe to science. Our relation to the physical side of things concerns us intimately; it is for our behoof to understand it. Practical or daily experience settles much of it for us, or up to a certain remove; beyond this, physical science settles it for us — the sources and nature of disease, the remedial forces of nature, the chemical compounds, the laws of hygiene and sanitation, the value of foods, and a thousand other things beyond the reach of our unaided experience, are in the keeping of science. We have the gift of life, and life demands that we understand things in their relation to our physical well-being.

Science has made or is making the world over for us. It has builded us a new house, — builded it over our heads while we were yet living in the old, and the confusion and disruption and the wiping-out of

the old features and the old associations have been, and still are, a sore trial, — a much finer, more spacious and commodious house, with endless improvements and conveniences, but new, new, all bright and hard and unfamiliar, with the spirit of newness; not yet home, not yet a part of our lives, not yet sacred to memory and affection.

The question now is: Can we live as worthy and contented lives there as our fathers and grandfathers did in their ruder, humbler dwelling-place? What we owe to science on our moral and æsthetic side it would not be so easy to say, but we owe it much. It is only when we arm our faculties with the ideas and the weapons of science that we appreciate the grandeur of the voyage we are making on this planet. It is only through science that we know we are on a planet, and are heavenly voyagers at all. When we get beyond the sphere of our unaided perceptions and experience, as we so quickly do in dealing with the earth and the heavenly bodies, science alone can guide us. Our minds are lost in the vast profound till science has blazed a way for us. The feeling of being lost or baffled may give rise to other feelings of a more reverent and pious character, as was the case with the early stargazers, but we can no longer see the heavens with the old eyes, if we would. Science enables us to understand our own ignorance and limitations, and so puts us at our ease amid the splendors and mys-

teries of creation. We fear and tremble less, but we marvel and enjoy more. God, as our fathers conceived him, recedes, but law and order come to the front. The personal emotion fades, but the cosmic emotion brightens. We escape from the bondage of our old anthropomorphic views of creation, into the larger freedom of scientific faith.

IV

Our civilization is so largely the result of physical science that we almost unconsciously impute all its ugly features to science.

But its ugly features can only indirectly be charged to science. They are primarily chargeable to the greed, the selfishness, the cupidity, the worldly-mindedness which has found in science the tools to further its ends. We can use our scientific knowledge to improve and beautify the earth, or we can use it to deface and exhaust it. We can use it to poison the air, corrupt the waters, blacken the face of the country, and harass our souls with loud and discordant noises, or we can use it to mitigate or abolish all these things. Mechanical science could draw the fangs of most of the engineering monsters that are devouring our souls. The howling locomotives that traverse the land, pouring out their huge black volumes of fetid carbon, and splitting our ears with their discordant noises, only need a little more science to purify their foul breaths and soften

their agonizing voices. A great manufacturing town is hideous, and life in it is usually hideous, but more science, more mechanical skill, more soul in capital, and less brutality in labor would change all these things.

Science puts great weapons in men's hands for good or for evil, for war or for peace, for beauty or for ugliness, for life or for death, and how these weapons are used depends upon the motives that actuate us. Science now promises to make war so deadly that it will practically abolish it. While we preach the gospel of peace our preparations for war are so exhaustive and scientific that the military spirit will die of an over-dose of its own medicine, and peace will fall of itself like a ripe fruit into our hands. A riotous, wasteful, and destructive spirit has been turned loose upon this continent, and it has used the weapons which physical science has placed in its hands in a brutal, devil-may-care sort of way, with the result that a nature fertile and bountiful, but never kind and sympathetic, has been outraged and disfigured and impoverished, rather than mellowed and subdued and humanized.

The beauty and joy of life in the Old World is a reflection from the past or pre-scientific age, to a degree of which we have little conception. In spite of our wealth of practical knowledge, and our unparalleled advantages (perhaps by very reason thereof, since humility of spirit is a flower that does

not flourish amid such rank growths), life in this country is undoubtedly the ugliest and most materialistic that any country or age ever saw. Our civilization is the noisiest and most disquieting, and the pressure of the business and industrial spirit the most maddening and killing, that the race has yet experienced.

Yet for all these things science is only indirectly responsible. In the same sense is the sun responsible for the rains and storms that at times destroy us. The spirit of greed and violence, robust because it has been well-housed and fed, and triply dangerous because it is well-armed and drilled, is abroad in the land. Science gave us dynamite, but whence the spirit that uses it to wreak private revenge, or to blow up railroad bridges and newspaper and manufacturing plants? Let us be just to science. Had it never been, the complexion of our lives and the face of the earth itself would have been vastly different. Had man never attained to the power of reason, he would still have been a brute with the other beasts. It takes power to use power. Knowledge without wisdom is a dangerous thing. Science without sense may bring us to grief. We cannot vault into the saddle of the elemental forces and ride them and escape the danger of being ridden by them. We cannot have a civilization propelled by machinery without the iron of it in some form entering our souls.

With our vast stores of scientific knowledge come the same problems that come with the accumulation of worldly wealth — how to acquire the one and not lose sight of the higher spiritual values, or become intellectually hard and proud, and how to obtain the other and not mortgage our souls to the devil; in short, in both cases, how to gain the whole world and not lose our own souls. It has been done, and can be done. Although Darwin confessed toward the end of his life that he had lost his interest in art, in literature, and in music, of which he was once so fond, he never lost his intellectual humility or gentleness and sweetness of soul, or grew weary in the pursuit of truth for its own sake. He had sought to trace the footsteps of the creative energy in animal life with such singleness of purpose and such devotion to the ideal that the lesson of his life tells for the attitude of mind called religious as well as for the attitude called scientific. His yearning, patient eyes came as near seeing the veil withdrawn from the mystery of the world of animal life as has ever been given to any man to see.

Huxley, the valiant knight in the evolutionary warfare, was not a whit behind him in the disinterested pursuit of scientific truth, while he led him in his interest in truths of a more purely subjective and intellectual character. Huxley was often accused of materialism, but he indignantly resented the charge. He was a scientific idealist, and he

shone like a holy crusader in following the Darwinian banner into the territory of the unbelievers.

V

One may question, after all, whether this oppression which our sensitive souls feel in the presence of the results of modern science be the fault of science or of our own lack of a certain mental robustness, or spiritual joy and vigor, that enables one to transmute and spiritualize science. Let us take courage from the examples of some of the great modern poets. Tennyson drew material, if not inspiration, from the two great physical sciences geology and astronomy, especially in his noblest long poem, "In Memoriam." Clearly they did not suggest to him a blank wall of material things. Later in his life he seems to have feared them as rivals: "Terrible Muses" he calls them, who might eclipse the crowned ones themselves, the great poets.

Our own Emerson was evidently stimulated by the result of physical science, and often availed himself, in his later poems and essays, of its material by way of confirming or illustrating the moral law upon which he was wont to string everything in reach. Emerson, in his eagerness for illustrative material in writing his essays, reminds one of the pressure certain birds are under when building their nests, — birds like the oriole, for instance. Hang pieces of colored yarn near the place where

the oriole is building its nest, and the bird seizes upon them eagerly and weaves them into the structure, not mindful at all of the obvious incongruity. Emerson in the fever of composition often snatched at facts of science that he had read in books or heard in lectures, and worked them into his text in the same way, always reinforcing his sentence with them. The solvent power of his thought seemed equal to any fact of physical science.

Whitman was, if anything, still more complacent and receptive in the presence of science. He makes less direct use of its results than either of the other poets mentioned, but one feels that he has put it more completely under his feet than they, and used it as a vantage-ground from which to launch his tremendous "I say."

> "I lie abstracted and hear the tale of things, and the reason of things,
> They are so beautiful I nudge myself to listen."

Addressing men of science he says, —

> "Gentlemen, to you the first honors always;
> Your facts are useful and yet they are not my dwelling;
> I but enter by them to an area of my dwelling," —

as all of us do who would live in a measure the life of the spirit. To Whitman the blank wall, if there was any wall, was in his area and not in his dwelling itself.

The same may be said of Henri Bergson whose recent volume, "Creative Evolution," is destined,

I believe, to mark an epoch in the history of modern thought. The work has its root in modern physical science, but it blooms and bears fruit in the spirit to a degree quite unprecedented.

When we can descend upon the materialism of the physical sciences with the spiritual fervor and imaginative power of the men I have named, the blank wall of material things will become as transparent as glass itself, and the chill will give place to intellectual warmth.

Bergson, to whom I have referred, is a new star in the intellectual firmament of our day. He is a philosopher upon whom the spirits of both literature and science have descended. In his great work he touches the materialism of science to finer issues. Probably no other writer of our time has possessed in the same measure the three gifts, the literary, the scientific, and the philosophical. Bergson is a kind of chastened and spiritualized Herbert Spencer.

Spencer was a philosopher upon whom the spirit of science alone had descended, and we miss in his work the quickening creative atmosphere, and that light that never was on sea or land, that pervades Bergson's. One thinks of Spencer as an enormous intellectual plant, turning out philosophical products that doubtless have their uses, but are a weary weight to the spirit. His work tends to a mechanical explanation of the universe and of the evolutionary impulse which Bergson, with his finer

and more imaginative endowment, helps us to escape. Bergson's work has its root in physical science also, but you run against no blank wall of material things in it. On the contrary, it has the charm of the ideal, and is luminous with insight into the more subtle and spiritual processes of the universe. "Creative Evolution" would have appealed to Goethe, and to our own Emerson and Whitman, and to all true idealists curious about the ways of creative power. It puts wings to the results of physical science as no other work with which I am acquainted has done in my time.

VI

We must face and accept the new conditions. They will seem less hard to our children's children than to us. If the old awe and reverence must go, the old fear and superstition must go with them. The religious ages begat a whole brood of imps and furies, — superstition, persecution, witchcraft, war, — and they must go, have gone, or are going. The new wonder, the new admiration, the new humanism, with the new scientific view of the universe, chilling though it be, must come in. We shall write less poetry, but we ought to live saner lives; we shall tremble and worship less, but we shall be more at home in the universe. War must go, the zymotic diseases must go, hidebound creeds must go, and a wider charity and sympathy come in.

There is nothing that fuses and unifies the nations like scientific knowledge, and the rational views that it inculcates — knowledge founded upon the universal nature which is in all countries the same. Science puts the same tools in all hands, the same views in all minds; we are no longer divided by false aims, or by religions founded upon half-views or false views. The local gives place to the universal. We come to see that all people are one, and that the well-being of each is the well-being of all, and *vice versa*. Distrust gives place to confidence; jealousy gives place to fellowship. Like knowledge begets like aims; the truths of nature make the whole world kin. The individual and the picturesque will suffer, local color will fade, but the human, the democratic, the average weal, will gain.

It must be said that literature has gained in many respects in this hurrying, economic age; it has gained in point and precision what it has lost in power. We are more impatient of the sham, the make-believe, the dilatory, the merely rhetorical and oratorical. We are more impatient of the obscure, the tedious, the impotent, the superfluous, the far-fetched. We have a new and a sharpened sense for the real, the vital, the logical. The dilatory and meandering methods of even such a writer as Hawthorne tire us a little now, and the make-believe of a Dickens is well-nigh intolerable. We want a story to move rapidly, we want the essay full of point and suggestion;

we find it more and more difficult to read books about books, and all writing "about-and-about" we are impatient of. We want the thing itself; we want currents and counter-currents — movement and rapidity at all hazards.

We are used to seeing the wheels go round; we feel the tremendous push of our civilization all about us; we see the straight paths, despite obstacles, that the controlled physical forces make over the earth's surface; we are masters of the science of short cuts in all departments of life; and both literature and philosophy respond to these conditions. Pragmatism has come in, dogmatism has gone out; the formal, the perfunctory, the rhetorical, count for less and less; the direct, the manly, the essential, count for more and more. Science has cured us of many delusions, and it has made us the poorer by dispelling certain illusions, but it has surely made the earth a much more habitable place than it was in the prescientific ages.

IV

THE HIT-AND-MISS METHOD OF NATURE

THE method of Nature seems to be an all-round-the-horizon one, without specific direction or discrimination. Or we may say that, whereas man's activity is in right lines toward definite predetermined ends, Nature's activity is in circles; her impetus goes out in all directions, so that she is sure, sooner or later, to reach her goal, because she covers all the ground. This method involves delay, waste, failures, — or what would be such to ourselves, — but they are a matter of indifference to the Infinite.

Man plans and builds and plants by method, order, system; he has eyes to see and hands to guide, and wit to devise: Nature builds and plants blindly, haphazardly, all around the circle; her hand-maidens are industrious but undirected.

The seeds of many plants are deftly concealed in tempting fruit which some creature will eat, and thus the hard-coated seeds will get disseminated. How many apple-trees and red thorn trees the cow plants! The seeds which her teeth do not crush escape from her body and are planted. It is a chance

hit, but Nature takes it, and wins often enough for her purpose. The superabundance of seed more than offsets this element of chance. The seeds which the winds carry travel to all points of the compass and fall blindly here and there; a hundred or a thousand fall where one finds its proper habitat.

Nature is pervaded with an intelligence that differs in kind from that of man — a blind, groping intelligence. Instead of taking short cuts, as man does, and saving time and waste, she beats all about the field, like a blind man looking for a gate. She succeeds because she persists, and moves in every direction. Her impulses are like the wavelet that a dropped pebble starts in the pool, which reaches every point upon the shore. She gets out of the woods because she travels to all points. The winds, the streams, the tides, do her errands; they search out every place; they "finger every shore"; they cover every square inch of ground. No matter how narrow the territory in which any species of plant thrives, if it is winged, and trusts itself to the wind, as most marsh plants do, it sooner or later finds its proper habitat.

The winged seeds of the cat-tail flag set out in fleets upon the air, cruising for ditches and swamps; they search all round the horizon, and sooner or later a few of them find what they were looking for; before you are aware of it, the ditch that drains your land is choked with a growth of cat-tail flag. I say

"find," when, in truth, they find nothing; they simply fall by chance upon the spots suitable for them, as a thirsty blind man might stumble upon a spring.

The spores of the black knot trust themselves blindly to the wind which bloweth where it listeth, and yet had they a thousand eyes they could not more surely find the plum or cherry trees or other hosts they are in need of. In autumn how many seeds of how many plants are waiting with hooks and barbs ready to seize on some passing creature and get free transportation to new lands! To cow's tail, to sheep's wool, to dog's hair, to men's clothing, they commit themselves and take their chances. Some one has written a book called "A Vagabond Journey around the World" — circling the globe without money or friends. How many plants have made this same journey, catching or stealing a ride here and there, tarrying in this country and in that, but sooner or later pressing forward!

This haphazard method of Nature is well illustrated by the experimental course of an animal in learning to do a new thing. The laboratory experimentalists tell us that when a rat or a cat learns to open a box to get food, it does so by an all-round-the-circle course of action. It proceeds as Nature does in her endless trials. The rat begins by running round and over the box that holds the food, gnawing the wires, pushing its nose into every mesh of the

wire screen, clawing, biting, and leaving no clue untried. This random trial-and-error course finally results in the proper means of reaching the food being hit upon. The child learns in the same hit-and-miss method, and we children of larger growth learn many things in the same way. We try, try, and try again, always profiting by our failures.

I saw Nature at her hit-and-miss method the other day when I saw a young but fully grown and half-tamed sparrow hawk try to release itself from the string by which it was held, and which had become much tangled about the foot. He picked and pulled at it blindly of course. If he persists long enough, I said, he will succeed; he will finally hit the loop that is the key to the whole tangle, and the string will fall free; which turned out to be the case. He made many ineffectual efforts, but after a time his trial-and-error process brought him the release he was striving for. The intelligence of the hawk, if we may call it such, showed itself in recognizing the fact that its movements were impeded by the tangled string, and that he might improve the situation. Of course it had no rational mental process about the matter, but obeyed the blind instinctive impulse to free itself from the string that held it.

The great continental ice-sheet in late Tertiary times drove all animal and plant life toward the Equator; when the ice-sheet retreated, the plants

and animals followed it back into the abandoned territory; but think what a hit-and-miss method the getting back must have been, especially to the plants and the trees! The animal life would wait upon the vegetable, upon which it depends, and the vegetable would wait upon the winds, or upon whatever forces of Nature were going their way. Slowly, in the course of many thousand years, they would go back and adapt themselves to the changed conditions. The plants and trees whose seeds are sown by the winds would probably take the lead; the fruit and nut-bearing trees which sustain, and, in turn, depend upon animal life to scatter them, would bring up the rear. The Pleistocene man, a rude savage, no doubt, with rude stone weapons and tools, would follow along as his means of subsistence allowed. The whole return of life to the vast glaciated region must have been a very slow, roundabout, hit-and-miss process, stretching over a very long period of time.

The sun itself is a type of Nature's wholesale, spendthrift method. It radiates its light and heat in every possible direction, and if we regard its function as the source of light and heat to the worlds revolving round it, what an incalculable waste goes on forever and ever! The amount of this life-giving solar radiance that falls on the planets is a fraction so small that it is like a grain of sand compared to the seashore. Yet probably, in our sense of the word,

there is no waste of anything in the universe. How can the Infinite waste or be wasted?

If we believe our astronomy, the evolution of suns and systems is often the result of the same fortuitous method of Nature. Two dark bodies, — burnt-out suns, — shooting at random through the depth of infinite space, collide, and the kinetic energy of the collision passes into the potential energy of heat, and the two bodies, or parts of them, become incandescent nebular matter which, in the course of incalculable time, condenses again into suns with their antecedent worlds. Our own planetary system may have been the result of such a chance collision of dead suns in the cosmic dramas of sidereal space.

This random method of Nature is again well illustrated in the case of the drones and the queen bee in the hive. The drones are there to fertilize the queen, and the queen is there to perpetuate the swarm, as she is the one mother bee in the hive. If she is not fertilized, her eggs produce drones and nothing else. Here again we see what a spendthrift Nature is in regard to the male principle. The case of the bees is analogous to the fertilization of the flowers by the agency of the wind — the same hit-and-miss procedure. A thousand minute grains of pollen are thrown to the winds, when one will do the work if it hits the mark. But the chances are that it will not hit the mark; so a thousand or more are fired blindly

into space, and the chances are thus a thousand times greater that the mark will be struck. One drone, and one chance meeting with the queen in the air, and the queen is fertilized; her eggs will now all produce worker or neuter bees. But this meeting of the queen in the air by the drone or male bee is quite a fortuitous matter: the day and hour of her flight is fortuitous, her course on the wing is fortuitous, and the course of the drone through the air is equally fortuitous.

The queen makes but one flight, and the fields of summer air in which she wanders are very wide, and the "spirit of the hive" has not advised any drone at what particular moment she will be at any particular point. The spirit of the hive has a simpler if a more wasteful method: it has developed many drones, several score of them, I should think, and they go forth every fair day and search the air in all directions during the period when the nuptial flight of the queen is likely to take place. One male some day, some moment, is doomed to meet her and yield his life for the swarm, as the worker bee yields her life when she stings an enemy in defense of the colony. Soon after the fertilization of the queen has taken place, the drones are all killed or expelled from the hive. It is a cruel fate from our point of view, and a wasteful method, but cruelty and waste in this sense do not trouble the cosmic or universal processes. The swarm thrives, the race of honey-bees

goes on, and that, apparently, is all that the gods of evolution are solicitous about.

The spirit of the hive has no further use for the drones, and the parsimony of Nature, which asserts itself, not for the individual but for the race, asserts itself now. It is hard to see how natural selection, which is looking after the fittest to survive, would bring about this result. This cumbersome, roundabout method of fertilizing the queen should have many disadvantages to the colony: the queen might be lost in her flight, caught by some flycatcher, or overwhelmed by a sudden storm; it is certain that many drones are caught by kingbirds in the air. Then this gang of drones has to be harbored and fed by the colony, which is no small item. The fittest and most economical process would be the fertilization of the queen in the hive, thus doing away with the superfluity of drones, which are certainly a tax upon the swarm. It is an unfit method which has as yet survived. The only possible advantage of it is the advantage of cross-fertilization which may occur where there are other colonies of bees in the neighborhood. Among our bumblebees this cross-fertilization does not take place, as I have frequently had occasion to observe.

The hit-and-miss method of Nature only means that Nature experiments like an inventor, tries and tries again, takes a long time, but knows when she hits the mark. Mechanical forces only seek an equi-

librium. The drones seek the queen, and the queen seeks the drones, from an inward inherited impulse. The tendrils of the vine reach out in all directions for support because there is the push of life behind them — something craving support.

It is this push of life that distinguishes the organic from the inorganic — this power of growth. Life is like a fountain in this respect. To suppress a fountain, you must needs change the soil and rocks from which it draws its water. Block its course, and it forms a new one; suppressed here, it breaks out there; there is a never-ceasing push and accumulation of the waters. It is as hard to suppress certain trees and plants as to extinguish a fountain; as long as the roots remain, the new tree, the new plant, is pushed out again. The organic life of the globe, considered as a whole, pushes out and on in the same way.

Nature takes her chances, but her system of things is so dovetailed together and is so flexible, and in the course of ages has worked itself out so completely, that sooner or later she makes her points. If I depended upon the winds or the floods or the animals to sow my seed or plant my trees, how extremely precarious would be my harvest of grain and of nuts and fruit. But this spring I saw a red squirrel carrying the butternuts out of the walls of my house where he had stored them last fall, and hiding them here and there under the leaves and dry grass

in the orchard, hiding them, I fancy, in obedience to some provident instinct, but really planting them on Nature's behalf, which, of course, means ultimately on his own behalf.

The heavy nuts — walnuts, butternuts, chestnuts, hickory-nuts — go unsown and rot or germinate in vain under the parent tree, unless some hungry animal carries them away as food. In the bare chance that this will happen, and that the nuts so carried will not all be eaten, but left where they can germinate, Nature finds her account. Crows and jays carry away acorns and chestnuts, but drop or hide a fair percentage of them, so that the trees get widely scattered.

This is a hit-and-miss method, but the hits are often enough to serve Nature's purpose; the game is played on such an extensive scale that forests of oak and chestnut and beech are the result.

The one thing in this universe that Nature has not been economical about is seed, and the fertilizing principle. See the clouds of pollen she throws to the wind from the pine-trees and from the grass in the meadows; if one grain in a hundred hits the mark her end is reached. It is by this heaping and overflowing measure that the element of chance is neutralized.

In the human world, over and above the play of will, purpose, reason, choice, there is the rule of impersonal Nature. The evolution of the race, of the nation, is not in obedience to human will or fore-

thought, and the things that delay it, or accelerate it, are as impersonal as the tides and the seasons.

The waste, the delays, the failures in human history, have been the same as in natural history. Wars, famines, pestilence, storms, and convulsions of nature have changed and delayed the course of national and racial development. In a certain limited sense, man is the architect of his own fortunes; in a larger sense, his communities and societies are under the law of organic evolution and subject to the failures and mishaps of natural bodies. The business of Nature is carried on without any reference to our ideas of prudence, or economic principles, or parsimony of effort, or our measure of success. Nature succeeds when one species destroys another, or when an earthquake blots out races of men. Nature does not balance her books in a day or in ten thousand days, but some sort of balance is kept in the course of the ages, else life would not be here. Disruption and decay finally bring about their opposites. Conflicting forces get adjusted and peace reigns. If all forces found the equilibrium to which they tend, we should have a dead world — a dead level of lifeless forces. But the play of forces is so complex, the factors that enter into our weather system even, are so many and so subtle and far-reaching, that we experience but little monotony. There is a perpetual seesaw everywhere, and this means life and motion.

I wonder if the life of the world, as we behold it, has reached this stage of development, not by direction, but by a conflict of forces? Was it determined by intrinsic necessity, or is it simply the result of extrinsic conditions and forces, like the course of the stream to the river and of the river to the sea?

The streams flow in all directions, yet sooner or later they reach the great reservoirs of lakes or seas. The rivulet has no eyes, no legs, no chart, no wit, but it will surely reach its goal — not by its own efforts or will, but by the law of mechanical forces acting upon its own fluidity or aquosity. Without gravitation working with variations of the earth's surface, it would never get there.

It seems to me that evolution, too, must work all around the circle; and had there not been some universal, underlying force analogous to gravity, and some modifying conditions in the environment, it would never have got anywhere.

Gravity gives to water the impulse to flow, or to seek a lower level; the conditions exterior to it determine where it shall flow.

It is the nature of life to flow, to seek new directions, to reach higher forms; the environment, the action, the reaction, and the interaction do the rest.

No extrinsic conditions could have made a man out of a worm, the man-scheme must have been in-

herent in the worm; but extrinsic conditions must have favored and guided the development of the higher form.

The moisture and the warmth do not determine the kind of plant or tree that shall arise from the seed you sow, but without them there would be no tree and no plant. Huxley's phrase, "the predestined evolution" of all forms of life, constantly comes to my mind: some inherent primordial bias or impulse or force that made the tree of life branch thus and thus and not otherwise, and that now before our eyes makes the pine branch one way, the oak another, the elm another.

We say that Nature is blind, but she has no need of eyes, she tries all courses: she has infinite time, infinite power, infinite space; and so far as our feeble minds can see, her delight is to play this game of blindman's buff over and over to all eternity. Her creatures get life, and the joy and pain that life brings, but what is augmented, or depleted, or concluded, or satisfied, or fulfilled, — who knows?

Could the appearance of man have been a fortuitous circumstance, something like an accident? Only in the sense that the appearance of anything else in nature is a fortuitous circumstance. Things in nature are not planned and provided for as we plan and provide for things. They all seem fortuitous when tried by our standards, like the storms. It seems like a sort of haphazard business; the

whole life of the globe does. Such delays, such waste, such blind groping, such hit-and-miss efforts, such apparent indifference on the part of Nature as to which combatant succeeds; life preying upon life, form devouring form, species after species becoming extinct, internecine war on every hand, clashing forces, clashing interests from one end of creation to the other; turmoil, defeat, failure, death, everywhere; the very elemental forces pitted against one another, — frost and heat, fluid and solid, growth and decay struggling for the mastery, the earth building up, the air and the rains pulling down, — yet out of this chaos and strife has come the flower, has come the grass, has come the bird, has come man, has come the "apple-blossomed earth" as we know it. Underneath and through all some kind of law and order has prevailed, something like will and purpose seem to have been at work.

Would creation have been a failure had man not appeared? From our point of view it certainly would, but how about the point of view of the All? The All is not to be tried by our standards. We cannot measure it or corner it with a question. Man did appear, and he seems the net outcome of the animal life of the globe; he has taken possession of it all as no other animal has or can; he masters the forces, he penetrates its secrets, he understands its mechanisms, he traces its laws, he grasps its meanings, he uses its treasures. All other animals are as stocks

and stones beside him. Until man appeared with his endowment of reason, his moral consciousness, the earth was a mere menagerie of blind savage forces. Hundreds of millions of years of mere growth and decay, birth and death, struggle and slaughter, building up and tearing down, submergence and elevation, erosion and denudation, sculpturing and shifting of land-forms; the rise and extinction and slow evolution — oh, so slow! — of animal forms. Millions of years of corals and trilobites, millions of years of mollusks and fishes, millions of years of reptiles and amphibians, ages of gigantic mammals, ages of quadrumana, before man appears: then ages of rude savage life before the dawn of civilization. If the Creator was aiming at man all these long geologic ages, groping his way through these low, and then through these gigantic repellent forms, how blindly and indifferently He seems to have worked!

Yet through this hit-and-miss method of Nature, things have come to what they are; life has come to what we behold it; the trees and the plants are in their places; the animals are adjusted to their environments; the seeds are sown, fruits ripen, the rains come, the weather system is established, and the vast and complex machinery of the life of the globe runs more or less smoothly, undirected, in the human sense. Blind groping, experimenting, regardless of waste, regardless of pain, regardless of

failure, circuitous, fortuitous, ambiguous, traversing the desert and the wilderness without chart or compass, beset by geologic, biologic, and cosmic catastrophes and delays, yet the great procession of the life of the globe, with man at its head, has arrived and entered into full possession of the inheritance prepared for it.

How difficult to think of it all as brought about by the random method of Nature which I have been discussing — a score of failures to one success, a hundred bullets astray to one that goes to the mark; and yet apparently such is the fact.

The course of evolution has been a wayward, blundering course.[1] The creative energy has felt its way from form to form, as an inventor feels his way in working out his ideas — failing, discarding, changing, but improving, advancing; and life is what it is because it had an onward and upward trend to begin with, and this inherent aspiration has never gone out. Life cannot stand still; it is its nature to develop, expand, increase. The sum of matter and the sum of force in the universe cannot be increased, but the sum of life has been increasing

[1] These and other remarks on life and evolution in this volume might have been borrowed from Henri Bergson's great work, "Creative Evolution," but they were not; they were all written long before I had ever heard Bergson's name. Readers of Kant and Goethe and our own Emerson got their minds fertilized by the non-mechanical (Bergsonian) idea of creation long before the advent of that philosopher.

from the first. Matter does not beget matter, but life does beget life.

Given this tendency to increase, to seek new forms, will natural selection do the rest? Start the worm, and in due time will man appear? The finite mind, the mind developed and disciplined in this world of effort, of rule and guidance, of cause and effect, fails to see how the unguided, the irresponsible, fortuitous action of a multitude of cells would and could build up the human body, or any other living body. Count and analyze every cell in a man's body, and you have not found the man: he is the result of all the myriads of cells acting in unison; he is the unit arising out of this vast multiplex series of units; they are all coördinated and working together to an end which no one of them, nor any group of them, knows. The man is a unit, the tree is a unit, the flower, the fruit, is a unit; each with form, structure, color, quality of its own, each made up and built up of an incalculable number of minute units, none of which have the secret of the key to the whole. There must be a plan which is not in the keeping of the cells. These units act together as the men of an army act together in battle, carrying out a system of manœuvres and of tactics, of which individually they know nothing.

Who does know? Whose plan is it? Who and where is the general who is conducting the campaign?

V

A BARN-DOOR OUTLOOK

I HAVE a barn-door outlook because I have a hay-barn study, and I chose a hay-barn study because I wanted a barn-door outlook — a wide, near view into fields and woods and orchards where I could be on intimate terms with the wild life about me, and with free, open-air nature.

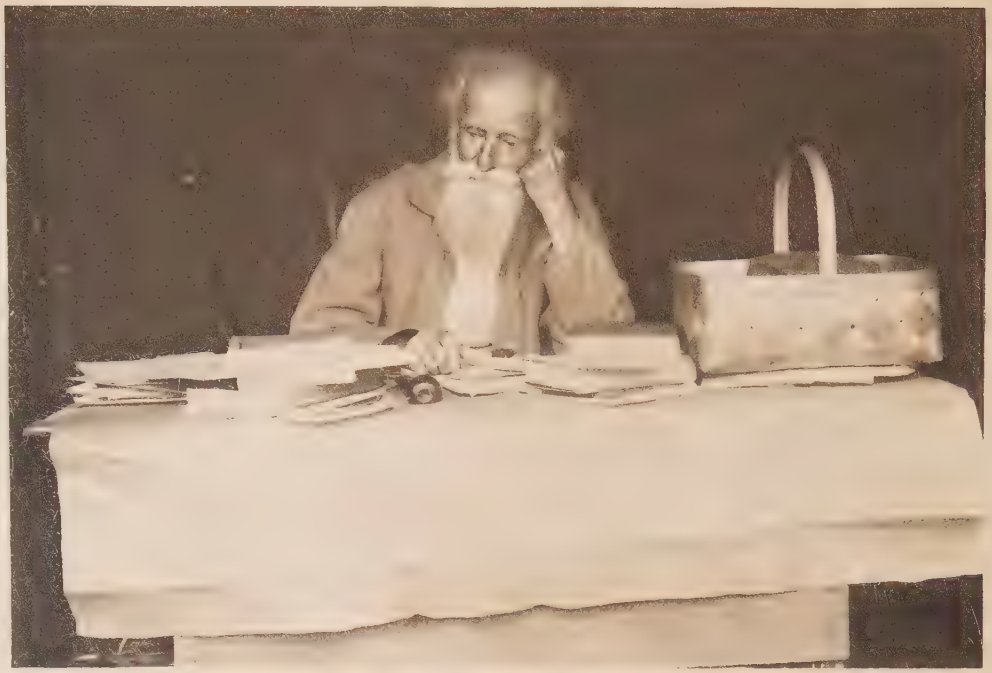
Usually there is nothing small or stingy about a barn door, and a farmer's hay-barn puts only a very thin partition between you and the outside world. Therefore, what could be a more fit place to thresh out dry philosophical subjects than a barn floor? I have a few such subjects to thresh out, and I thresh them here, turning them over as many times as we used to turn over the oat and rye sheaves in the old days when I wielded the hickory flail with my brothers on this same barn floor.

What a pleasure it is to look back to those autumn days, generally in September or early October, when we used to thresh out a few bushels of the new crop of rye to be taken to the grist-mill for a fresh supply of flour! How often we paused in our work to munch apples that had been mellowing in the haymow by our side, and look out through the

big doorway upon the sunlit meadows and hill-slopes! The sound of the flail is heard in the old barn no more, but in its stead the scratching of a pen and the uneasy stirring of a man seated there behind a big box, threshing out a harvest for a loaf of much less general value.

As I sit here day after day, bending over my work, I get many glimpses of the little rills of wild life that circulate about me. The feature of it that impresses me most is the life of fear that most of the wild creatures lead. They are as alert and cautious as are the picket-lines of opposing armies. Just over the line of stone wall in the orchard a woodchuck comes hesitatingly out of his hole and goes nibbling in the grass not fifty feet away. How alert and watchful he is! Every few moments he sits upright and takes an observation, then resumes his feeding. When I make a slight noise he rushes to the cover of the stone wall. Then, as no danger appears, he climbs to the top of it and looks in my direction. As I move as if to get up, he drops back quietly to his hole.

A chipmunk comes along on the stone wall, hurrying somewhere on an important errand, but changing his course every moment. He runs on the top of the wall, then along its side, then into it and through it and out on the other side, pausing every few seconds and looking and listening, careful not to expose himself long in any one position, really



skulking and hiding all along his journey. His enemies are keen and watchful and likely to appear at any moment, and he knows it, not so much by experience as by instinct. His young are timid and watchful the first time they emerge from the den into the light of day.

Then a red squirrel comes spinning along. By jerks and nervous, spasmodic spurts he rushes along from cover to cover like a soldier dodging the enemy's bullets. When he discovers me, he pauses, and with one paw on his heart appears to press a button, that lets off a flood of snickering, explosive sounds that seem like ridicule of me and my work. Failing to get any response from me, he presently turns, and, springing from the wall to the bending branch of a near apple-tree, he rushes up and disappears amid the foliage. Presently I see him on the end of a branch, where he seizes a green apple not yet a third grown, and, darting down to a large horizontal branch, sits up with the apple in his paws and proceeds to chip it up for the pale, unripe seeds at its core, all the time keenly alive to possible dangers that may surround him. What a nervous, hustling, highstrung creature he is — a live wire at all times and places! That pert curl of the end of his tail, as he sits chipping the apple or cutting through the shell of a nut, is expressive of his character. What a contrast his nervous and explosive activity presents to the more sedate and dignified life of the

gray squirrel! One of these passed us only a few yards away on our walk in the woods the other day — a long, undulating line of soft gray, silent as a spirit and graceful as a wave on the beach.

A little later, in the fine, slow-falling rain, a rabbit sudddenly emerges into my field of vision fifty feet away. How timid and scared she looks! She pauses a moment amid the weeds, then hops a yard or two and pauses again, then passes under the bars and hesitates on the edge of a more open and exposed place immediately in front of me. Here she works her nose, feeling of every current of air, analyzing every scent to see if danger is near. Apparently detecting something suspicious in the currents that drift from my direction, she turns back, pauses again, works her nose as before, then hurries out of my sight.

Yesterday I saw a rat stealing green peas from my garden in the open day. He darted out of the stone wall six or eight feet away to the row of peas, rushed about nervously among the vines; then, before I could seize my rifle, darted back to the cover of the wall. Once I cautiously approached his hiding-place in the wall and waited. Presently his head emerged from the line of weeds by the fence, his nose began working anxiously, he sifted and resifted the air with it, and then quickly withdrew; his nose had detected me, but his eye had not. The touchstone of most animals is the nose, and not the

eye. The eye quickly detects objects in motion, but not those at rest; this is the function of the nose.

A highhole alights on the ground in full view in the orchard twenty yards away, and, spying my motionless figure, pauses and regards me long and intently. His eye serves him, and not his nose. Finally concluding that I am not dangerous, he stoops to the turf for his beloved ants and other insects, but lifts his head every few seconds to see that no danger is imminent. Not one moment is he off his guard. A hawk may suddenly swoop from the air above, or a four-footed foe approach from any side. I have seen a sharp-shinned hawk pick up a highhole from the turf in a twinkling under just such conditions. What a contrast between the anxious behavior of these wild creatures and the ease and indifference of the grazing cattle!

All the wild creatures evidently regard me with mingled feelings of curiosity and distrust. A song sparrow hops and flirts and attitudinizes and peers at me from the door-sill, wondering if there is any harm in me. A phœbe-bird comes in and flits about, disturbed by my presence. For the third or fourth time this season, I think, she is planning a nest. In June she began one over a window on the porch where I sleep in the open air. She had the foundation laid when I appeared, and was not a little disturbed by my presence, especially in the early morning, when I wanted to sleep and she wanted to

work. She let fall some of her mortar upon me, but at least I had no fear of a falling brick. She gradually got used to me, and her work was progressing into the moss stage when two women appeared and made their beds upon the porch, and in the morning went to and fro with brooms, of course. Then Phœbe seemed to say to herself, "This is too much," and she left her unfinished nest and resorted to the empty hay-barn. Here she built a nest on one of the bark-covered end timbers halfway up the big mow, not being quite as used to barns and the exigencies of haying-times as swallows are, who build their mud nests against the rafters in the peak. She had deposited her eggs, when the haymakers began pitching hay into the space beneath her; sweating, hurrying haymakers do not see or regard the rights or wants of little birds. Like a rising tide the fragrant hay rose and covered the timber and the nest, and crept on up toward the swallow's unfledged family in the peak, but did not quite reach it.

Phœbe and her mate hung about the barn disconsolate for days, and now, ten days later, she is hovering about my open door on the floor below, evidently prospecting for another building-site. I hope she will find me so quiet and my air so friendly that she will choose a niche on the hewn timber over my head. Just this moment I saw her snap up a flying "miller" in the orchard a few rods away. She was compelled to swoop four times before she inter-

cepted that little moth in its unsteady, zigzagging flight. She is an expert at this sort of thing; it is her business to take her game on the wing; but the moths are experts in zigzag flying, and Phœbe missed her mark three times. I heard the snap of her beak at each swoop. It is almost impossible for any insectivorous bird except a flycatcher to take a moth or a butterfly on the wing.

Last year in August the junco, or common snowbird, came into the big barn and built her nest in the side of the haymow, only a few feet from me. The clean, fragrant hay attracted her as it had attracted me. One would have thought that in a haymow she had nesting material near at hand. But no; her nest-building instincts had to take the old rut; she must bring her own material from without; the haymow was only the mossy bank or the wood-side turf where her species had hidden their nests for untold generations. She did not weave one spear of the farmer's hay into her nest, but brought in the usual bits of dry grass and weeds and horsehair and shaped the fabric after the old pattern, tucking it well in under the drooping locks of hay. As I sat morning after morning weaving my thoughts together and looking out of the great barn doorway into sunlit fields, the junco wove her straws and horsehairs, and deposited there on three successive days her three exquisite eggs.

Why the bird departed so widely from the usual

habits of nest-building of her species, who can tell? I had never before seen a junco's nest except on the ground in remote fields, or in mossy banks by the side of mountain roads. This nest is the finest to be found upon the ground, its usual lining of horsehair makes its interior especially smooth and shapely, and the nest in the haymow showed only a little falling-off, as is usually the case in the second nest of the season. The songs of the birds, the construction of their nests, and the number of their eggs taper off as the season wanes.

The junco impresses me as a fidgety, emphatic, feather-edged sort of bird; the two white quills in its tail which flash out so suddenly on every movement seem to stamp in this impression. My junco was a little nervous at first and showed her white quills, but she soon grew used to my presence, and would alight upon the chair which I kept for callers, and upon my hammock-ropes.

When an artist came to paint my portrait amid such rustic surroundings, the bird only eyed her a little suspiciously at first, and then went forward with her own affairs. One night the wind blew the easel with its canvas over against the haymow where the nest was placed, but the bird was there on her eggs in the morning. Her wild instincts did not desert her in one respect, at least: when I would flush her from the nest she would drop down to the floor and with spread plumage and fluttering move-

ments seek for a moment to decoy me away from the nest, after the habit of most ground-builders. The male came about the barn frequently with three or four other juncos, which I suspect were the first or June brood of the pair, now able to take care of themselves, but still held together by the family instinct, as often happens in the case of some other birds, such as bluebirds and chickadees.

My little mascot hatched all her eggs, and all went well with mother and young until, during my absence of three or four days, some night-prowler, probably a rat, plundered the nest, and the little summer idyl in the heart of the old barn abruptly ended. I saw the juncos no more.

While I was so closely associated with the junco in the old barn I had a good chance to observe her incubating habits. I was surprised at the frequent and long recesses that she took during school-hours. Every hour during the warmest days she was off from ten to twelve minutes, either to take the air or to take a bite, or to let up on the temperature of her eggs, or to have a word with her other family; I am at a loss to know which. Toward the end of her term, which was twelve days, and as the days grew cooler, she was not gadding out and in so often, but kept her place three or four hours at a time.

When the young were hatched they seemed mainly fed with insects — spiders or flies gathered off the timbers and clapboards of the inside of the

barn. It was a pretty sight to see the mother-bird making the rounds of the barn, running along the timbers, jumping up here and there, and seizing some invisible object, showing the while her white petticoats — as a French girl called that display of white tail-feathers.

Day after day and week after week as I look through the big, open barn door I see a marsh hawk beating about low over the fields. He, or rather she (for I see by the greater size and browner color that it is the female), moves very slowly and deliberately on level, flexible wing, now over the meadow, now over the oat or millet field, then above the pasture and the swamp, tacking and turning, her eye bent upon the ground, and no doubt sending fear or panic through the heart of many a nibbling mouse or sitting bird. She occasionally hesitates or stops in her flight and drops upon the ground, as if seeking insects or frogs or snakes. I have never yet seen her swoop or strike after the manner of other hawks. It is a pleasure to watch her through the glass and see her make these circuits of the fields on effortless wing, day after day, and strike no bird or other living thing, as if in quest of something she never finds. I never see the male. She has perhaps assigned him other territory to hunt over. He is smaller, with more blue in his plumage. One day she had a scrap or a game of some kind with three or four crows on the side of a rocky hill.

I think the crows teased and annoyed her. I heard their cawing and saw them pursuing the hawk, and then saw her swoop upon them or turn over in the air beneath them, as if to show them what feats she could do on the wing that were beyond their powers. The crows often made a peculiar guttural cawing and cackling as if they enjoyed the sport, but they were clumsy and awkward enough on the wing compared to the hawk. Time after time she came down upon them from a point high in the air, like a thunderbolt, but never seemed to touch them. Twice I saw her swoop upon them as they sat upon the ground, and the crows called out in half sportive, half protesting tones, as if saying, "That was a little too close; beware, beware!" It was like a skillful swordsman flourishing his weapon about the head of a peasant; but not a feather was touched so far as I could see. It is the only time I ever saw this hawk in a sportive or aggressive mood. I have seen jays tease the sharp-shinned hawk in this way, and escape his retaliating blows by darting into a cedar-tree. All the crow tribe, I think, love to badger and mock some of their neighbors.

How much business the crows seem to have apart from hunting their living! I hear their voices in the morning before sun-up, sounding out from different points of the fields and woods, as if every one of them were giving or receiving orders for the day: 'Here, Jim, you do this; here, Corvus, you go there,

and put that thing through"; and Jim caws back a response, and Corvus says, "I 'm off this minute." I get the impression that it is convention day or general training day with them. There are voices in all keys of masculinity and femininity. Here and there seems to be one in authority who calls at intervals, "Haw-ah, haw, haw-ah!" Others utter a strident "Haw!" still others a rapid, feminine call. Some seem hurrying, others seem at rest, but the landscape is apparently alive with crows carrying out some plan of concerted action. How fond they must be of one another! What boon companions they are! In constant communication, saluting one another from the trees, the ground, the air, watchful of one another's safety, sharing their plunder, uniting against a common enemy, noisy, sportive, predacious, and open and aboveboard in all their ways and doings — how much character our ebony friend possesses, in how many ways he challenges our admiration!

What a contrast the crow presents to the silent, solitary hawk! The hawks have but two occupations — hunting and soaring; they have no social or tribal relations, and make no show of business as does the crow. The crow does not hide; he seems to crave the utmost publicity; his goings and comings are advertised with all the effectiveness of his strident voice; but all our hawks are silent and stealthy.

Let me return to the red squirrel, because he returns to me hourly. He is the most frisky, diverting, and altogether impish of all our wild creatures. He is a veritable Puck. All the other wild folk that cross my field of vision, or look in upon me here in my fragrant hay-barn study, seem to have but one feeling about me: "What is it? Is it dangerous? Has it any designs upon me?" But my appearance seems to awaken other feelings in the red squirrel. He pauses on the fence or on the rail before me, and goes through a series of antics and poses and hilarious gestures, giving out the while a stream of snickering, staccato sounds that suggest unmistakably that I am a source of mirth and ridicule to him. His gestures and attitudes are all those of mingled mirth, curiosity, defiance, and contempt — seldom those of fear. He comes spinning along on the stone wall in front of me, with those abrupt, nervous pauses every few yards that characterize all his movements. On seeing me he checks his speed, and with depressed tail impels himself along, a few inches at a time, in a series of spasmodic starts and sallies; the hind part of his body flattened, and his legs spread, his head erect and alert, his tail full of kinks and quirks. How that tail undulates! Now its end curls, now it is flattened to the stone, now it springs straight up as if part of a trap, hind feet the while keeping time in a sort of nervous dance with the shrill, strident cackling and snickering. The next moment he is

sitting erect with fore paws pressed against his white chest, his tail rippling out behind him or up his back, and his shrill, nasal tones still pouring out. He hops to the next stone, he assumes a new position, his tail palpitates and jerks more lively than ever; now he is on all fours, with curved back; now he sits up at an angle, his tail all the time charged with mingled suspicion and mirth. Then he springs to a rail that runs out at right angles from the wall toward me, and with hectoring snickers and shrill trebles, pointed straight at me, keeps up his performance. What an actor he is! What a furry embodiment of quick, nervous energy and impertinence! Surely he has a sense of something like humor; surely he is teasing and mocking me and telling me, both by gesture and by word of mouth, that I present a very ridiculous appearance.

A chipmunk comes hurrying along with stuffed cheek-pouches, traveling more on the side of the wall than on the top, stopping every few yards to see that the way is clear, but giving little heed to me or to the performing squirrel. In comparison the chipmunk is a demure, preoccupied, pretty little busybody who often watches you curiously, but never mocks you or pokes fun at you; while the gray squirrel has the manners of the best-bred wood-folk, and he goes his way without fuss or bluster, a picture of sylvan grace and buoyancy.

All the movements of the red squirrel are quick,

sharp, jerky, machine-like. He does nothing slowly or gently; everything with a snap and a jerk. His progression is a series of interrupted sallies. When he pauses on the stone wall he faces this way and that with a sudden jerk; he turns round in two or three quick leaps. So abrupt and automatic in his movements, so stiff and angular in behavior, yet he is charged and overflowing with life and energy. One thinks of him as a bundle of steel wires and needles and coiled springs, all electrically charged. One of his sounds or calls is like the buzz of a reel or the whirr of an alarm-clock. Something seems to touch a spring there in the old apple-tree, and out leaps this strident sound as of spinning brass wheels.

When I speak sharply to him, in the midst of his antics, he pauses a moment with uplifted paw, watching me intently, and then with a snicker springs upon a branch of an apple-tree that hangs down near the wall, and disappears amid the foliage. The red squirrel is always actively saucy, aggressively impudent. He peeps in at me through a broken pane in the window and snickers; he strikes up a jig on the stone underpinning twenty feet away and mocks; he darts in and out among the timbers and chatters and giggles; he climbs up over the door, pokes his head in, and lets off a volley; he moves by jerks along the sill a few feet from my head and chirps derisively; he eyes me from points on the wall

in front, or from some coign of vantage in the barn, and flings his anger or his contempt upon me.

No other of our wood-folk has such a facile, emotional tail as the red squirrel. It seems as if an electric current were running through it most of the time; it vibrates, it ripples, it curls, it jerks, it arches, it flattens; now it is like a plume in his cap; now it is a cloak around his shoulders; then it is an instrument to point and emphasize his states of emotional excitement; every movement of his body is seconded or reflected in his tail. There seems to be some automatic adjustment between his tail and his vocal machinery.

The tail of the gray squirrel shows to best advantage when he is running over the ground in the woods — and a long, graceful, undulating line of soft silver gray the creature makes! In my part of the country the gray squirrel is more strictly a wood-dweller than the red, and has the grace and elusiveness that belong more especially to the sylvan creatures.

The red squirrel can play a tune and accompany himself. Underneath his strident, nasal snicker you may hear a note in another key, much finer and shriller. Or it is as if the volume of sound was split up into two strains, one proceeding from his throat and the other from his mouth.

If the red squirrels do not have an actual game of tag, they have something so near it that I cannot tell the difference. Just now I see one in hot pursuit

of another on the stone wall; both are apparently going at the top of their speed. They make a red streak over the dark-gray stones. When the pursuer seems to overtake the pursued and becomes "It," the race is reversed, and away they go on the back track with the same fleetness of the hunter and the hunted, till things are reversed again. I have seen them engaged in the same game in tree-tops, each one having his innings by turn.

The gray squirrel comes and goes, but the red squirrel we have always with us. He will live where the gray will starve. He is a true American; he has nearly all the national traits — nervous energy, quickness, resourcefulness, pertness, not to say impudence and conceit. He is not altogether lovely or blameless. He makes war on the chipmunk, he is a robber of birds' nests, and is destructive of the orchard fruits. Nearly every man's hand is against him, yet he thrives, and long may he continue to do so!

One day I placed some over-ripe plums on the wall in front of me to see what he would do with them. At first he fell eagerly to releasing the pit, and then to cutting his way to the kernel in the pit. After one of them had been disposed of in this way, he proceeded to carry off the others and place them here and there amid the branches of a plum-tree from which he had stolen every plum long before they were ripe. A day or two later I noted that they had all been removed

from this tree, and I found some of them in the forks of an apple-tree not far off.

A small butternut-tree standing near the wall had only a score or so of butternuts upon it this year; the squirrels might be seen almost any hour in the day darting about the branches of that tree, hunting the green nuts, and in early September the last nut was taken. They carried them away and placed them, one here and one there, in the forks of the apple-trees. I noticed that they did not depend upon the eye to find the nuts; they did not look the branches over from some lower branch as you and I would have done; they explored the branches one by one, running out to the end, and, if the nut was there, seized it and came swiftly down. I think the red squirrel rarely lays up any considerable store, but hides his nuts here and there in the trees and upon the ground. This habit makes him the planter of future trees, of oaks, hickories, chestnuts, and butternuts. These heavy nuts get widely scattered by this agency.

One morning I saw a chipmunk catch a flying grasshopper on the wing. Little Striped-Back sat on the wall with stuffed pockets, waiting for something, when along came the big grasshopper in a hesitating, uncertain manner of flight. As it hovered above the chipmunk, the latter by a quick, dexterous movement sprang or reached up and caught it, and in less than one half-minute its fanlike wings

were opening out in front of the captor's mouth and its body was being eagerly devoured. This same chipmunk, I think it is, has his den under the barn near me. Often he comes from the stone wall with distended cheek-pouches, and pauses fifteen feet away, close by cover, and looks to see if any danger is impending. To reach his hole he has to cross an open space a rod or more wide, and the thought of it evidently agitates him a little. I am sitting there looking over my desk upon him, and he is skeptical about my being as harmless as I look. "Dare I cross that ten feet of open there in front of him?" he seems to say. He sits up with fore paws pressed so prettily to his white breast. He is so near I can see the rapid throbbing of his chest as he sniffs the air. A moment he sits and looks and sniffs, then in hurried movements crosses the open, his cheek-pockets showing full as he darts by me. He is like a baseball runner trying to steal a base: danger lurks on all sides; he must not leave the cover of one base till he sees the way is clear, and then — off with a rush! Pray don't work yourself up to such a pitch, my little neighbor; you shall make a home-run without the slightest show of opposition from me.

One day a gray squirrel came along on the stone wall beside the road. In front of the house he crossed an open barway, and then paused to observe two men at work in full view near the house. The men were a sculptor, pottering with clay, and his

model. The squirrel sprang up a near-by butternut-tree, sat down on a limb, and had a good, long look. "Very suspicious," he seemed to think; "maybe they are fixing a trap for me"; and he deliberately came down the tree and returned the way he had come, spinning along the top of the wall, his long, fine tail outlined by a narrow band of silver as he sped off toward the woods.

VI

THE ANIMAL MIND

I

WHEN I try to picture to myself the difference between the animal mind and the human mind, I seem to see the animal mind as limited by the organization and the physical needs of its possessor in a sense that the mind of man is not; its mental faculties, if we may call them such, are like its tools and weapons, a part of its physical make-up, and are almost entirely automatic in their action. Almost, I say; but, in the case of the higher animals, not entirely so. In the anthropoid apes, in the dog, in the elephant, and maybe occasionally in some others, there do seem to be at times the rudiments of free intelligence, something like mind emancipated from the bondage of organization and inherited habit.

When an animal acts in obedience to its purely physical needs and according to its anatomical structure, as when ducks take to the water, or hens scratch, or hogs root, or woodpeckers drill, we do not credit it with powers of thought. These and similar things animals do instinctively. When the wood-mice got into my cabin the other day and

opened two small glass jars of butter that had loose tin tops, I did not credit them with anything like human intelligence, because to use their paws deftly — digging, climbing, manipulating — is natural to mice. I have seen a chipmunk come into a house from his den in the woods and open a pasteboard box with great deftness, and help himself to the nuts inside, which, of course, he smelled. We do not credit a bird with rational intelligence when it builds its nest, no matter how skillfully it may weave or sew, or how artfully it may hide it from its enemies. It is doing precisely as its forebears have done for countless generations. Hence it acts from inherited impulse.

But the monkey I was told about at the zoölogical park in Washington, that had been seen to select a stiff straw from the bottom of its cage, and use it to dislodge an insect from a crack, showed a gleam of free intelligence. It was an act of judgment on the part of the monkey, akin to human judgment. In like manner the chimpanzee Mr. Hornaday tells about, that used the trapeze-bar in the cage as a lever with which to pry off the horizontal bars on the side of the cage, and otherwise to demolish things, showed a kind of intelligence that is above instinct, and quite beyond the capacity, say, of a dog.

I would not say, as Mr. Hornaday does, that this ape discovered the principle of the lever as truly as Archimedes did. Would it not be better to say that

he discovered the *use* to which he could put that particular stick, without any notion of the principle involved? — just as he had doubtless found out that an object, or his own body unsupported, would fall to the floor of his cage, without having grasped the principle of gravitation.

The earliest men must have discovered the uses of the lever long before they had any true understanding of its principle. I do not believe that any of the orders below man grasp principles at all, though they may apply a principle in their act. The beaver applies the principle of the dam to the creek where he locates his house, but to say that he works from an intellectual conception of that principle, I think, would be to lift him to the human plane at once. The swallow, and the robin, and the phœbe-bird, all act upon the principle that mud will adhere to a rough surface, and that it will harden; shall we, therefore, credit them with a knowledge of the properties of mud? However, I freely admit that the act of the chimpanzee was of a higher order than the swallow's use of mud in sticking its nest to a rough surface. Its superior intelligence is seen in its purposeful use of a tool, an object in no wise related to itself, to bring about a definite end; just as another monkey of which Mr. Hornaday speaks used a stick to punch a banana out of a pipe.

I do not agree with those who urge that an animal, such as the beaver for instance, gives proof

of its gift of reason when it amputates its leg in order to escape from a trap. I dissent from it for several reasons. Animals apparently much lower in the scale of intelligence than the beaver, such as the muskrat and the skunk, will do the same thing; and animals much higher, such as the dog, the fox, the wolf, will not do it. Indeed, it has been found that an all but brainless animal, like the starfish, will do a similar thing. In order to get free of a piece of rubber tubing placed over one of its arms, the starfish has, after exhausting other expedients, been known to amputate the arm. Hence, I infer that the beaver, caught in a trap, does not reason about it, and "reach the conclusion that he must inflict upon himself the pain of amputating his foot." He only shows the promptings of a very old and universal instinct, the instinct of self-preservation.

Every creature, little and big, that has powers of locomotion, struggles against that which would forcibly hold it, or which opposes it. A cricket or a grasshopper will leave a leg in your hand in order to escape. Try forcibly to retain the paw of your dog, or your cat, and see how it will struggle to be free. A four-footed animal caught in a trap is filled with rage and pain; it bites at everything within reach — the bushes, the logs, the rocks; of course it bites the trap, but upon the steel its teeth make no impression. If the animal is small, and the season is winter, the part of the foot that protrudes on the

inside of the jaws of the trap soon becomes numb and dead or frozen, and is gnawed off. The leg above the trap may become frozen and senseless, and the amputation of it give little pain.

Trappers tell us that bears often resort to all manner of devices to get rid of the trap, some of which seem very intelligent, as, for instance, when they climb a tree, and, getting the trap fast amid the branches, bring their weight to bear upon it, thus calling in the aid of gravity. But I would as soon think that such behavior on the part of the bear was the result of a reasoning process — a knowledge of the force of gravity — as I would attribute reason to a tree because it tries to assume the perpendicular, or to clouds, because they soar aloft in order to let down the rain. The bear is doing his best to get his paw out of the jaws of the trap, and in his blind fury and desperation he climbs a tree and tries to detach the trap there, but only succeeds in getting it fast, when, as a matter of course, he drops down and pulls out. He could have pulled his own weight and more upon the ground had he got the trap fast. The trapper's hope is that he will not get it fast.

We reason for the brute when we interpret its action in this way. I do not suppose that with the anger, or joy, or fear, or love-making, of our brute neighbors there goes any idea, or mental process, or image whatever; only involuntary impulses stimulated by outward conditions. We ourselves are often

happy without thought, scared without reason, angry without volition, and act from spontaneous impulse. I suppose that if man were not a reasonable being he would never laugh, because it is the perception of some sort of incongruity that makes us laugh, though we may not be conscious of it.

Animals never laugh, and probably never experience in any degree the emotion that makes us laugh, because their minds do not perceive incongruities. Such perception is an intellectual act that is beyond them. The incongruous only strikes them as something strange, and excites their suspicion or their fears. When one day I suddenly appeared before my dog in a suit of khaki, a garb in which he had never before seen me, did it excite his mirth, as it did that of some of my neighbors? On the contrary, it alarmed him; he hesitated a moment, showing conflicting emotions, then edged away suspiciously, and when I made a hostile demonstration towards him, fled precipitately in a high state of anger and excitement. Not till I spoke to him in the old tone did he recover himself and approach me in a humiliated, apologetic way.

Our anger, our joy, our sex love, our selfishness, our cruelty, are of animal origin; but our sense of the ludicrous, which is the basis of our wit and humor, our hope, our faith, our feeling of reverence, of altruism, of worship, are above the animal sphere, as is the faculty of reason. They are of animal

origin only in the sense that man himself is of animal origin. They are not endowments from some external or extra-human source. They must have been potential in the lower orders just as our limbs were potential in the fins of the fish, and our lungs potential in its air-bladder. Evolution must always have something to go upon, but that something may be quite beyond our human ken, as it certainly is in the case of man's higher nature. It is much easier to trace the feather of the bird to the scale of the fish than it is to trace our moral nature to its animal origin. Yet this is the only possible source science can assign to it, because it is the only source that falls within the sphere of physical causation, the only causation science knows.

When the lower animals laugh, I shall believe they have the faculty of reason also. Think how long man must have lived before he became a laughing animal — before he was sufficiently developed mentally to take note of incongruities, or for this or that object or incident to excite his mirth instead of his fear! When I first saw a trolley-car running along the street without any apparent means of propulsion, it excited my surprise and curiosity. When my horse first saw it, he was filled with alarm. I do not suppose my horse had the same mental process about it that I had; an effect without an apparent cause could have been nothing to him. He was moved simply by the strangeness of the

spectacle. It was a sight the like of which he had never seen before.

Stories are told of monkeys that would seem to indicate in them some perception of the humorous, however rudimentary, but I recall nothing of the kind in the other animals. Of course the impulse of play in animals springs from another source — the instinct to develop the particular powers that their life-careers will most require. Puppies and kittens fight mock battles and pursue and capture mock game, kids leap and bound, colts run and leap, birds swoop and dive as if to escape a hawk: in each case training the powers that are likely to be the most useful to them in after-life. Our play-instinct is no doubt of animal origin, but not in the same sense is our perception of the humorous of animal origin. It originated in man, as did so many of the higher emotions.

II

One of the best illustrations I ever had of the difference between animal and human behavior under like conditions, was afforded me one May day in the woods, when I unwittingly pulled down the stub of a small tree in which a pair of bluebirds had a nest and young. Now, if a man were to come home and find his house gone, and only empty space where it had stood, he would not go up to the place where the door had been and try repeatedly to find

the entrance. But this is exactly what the bluebirds did. As I have elsewhere described, I had pulled down the stub that held their nest and young, not knowing there was a nest there; and then on discovering my mistake had set the stub up again twelve or fifteen feet from where I had found it. Presently the mother bird came with food in her bill, and alighted on a limb a few feet above the spot where the trunk of the tree holding her nest had been, and where, doubtless, she was in the habit of alighting. She must have seen at once that her house was gone, but if she did, the fact made no impression upon her.

Quite undisturbed, she dropped down to the point in the vacant space where the entrance to her nest used to be. She hovered there a moment and then, apparently greatly bewildered, flew back to the perch above. She waited there a moment, peering downward, and then tried it again. Could she not see that her house was gone? But the force of habit was stronger with her than any free intelligence she might possess. She had always found the nest there and it must be there still. An animal's reflexes are not influenced by the logic of the situation. Down she came again and hovered a moment at the point of the vanished nest, vainly seeking the entrance. This movement she repeated over and over. I have no doubt that she came each time to the precise spot in the air where her treasures had

been. It seemed as if she could not convince herself that the nest was not there. She had brought a beetle in her bill, and this she hammered upon the limb each time she perched, as if it in some way might be at fault. How her blue wings flickered in the empty air above the dark water, and not more than ten or twelve feet from the actual visible entrance to the nest she had lost!

Presently she dropped her bug and flew off through the woods calling for her mate. Her action seemed very human. Surely he would clear up the mystery. In a moment or two, both birds, with food in their bills, were perched upon the branch a few feet above the spot where the nest had been. I can recall yet the confident air with which the male dropped down to that vacant spot. Could he not see that there was nothing there? No, seeing was not convincing. He must do just as he had done so many times before. He tried it again and again; then the two birds took turns in trying it. They assaulted the empty air vigorously, persistently, as if determined that it must give up their lost ones. Finally they perched upon a branch higher up and seemed to pause to consider. The machines ceased to act. At this instant the mother bird spied the hole that was the entrance to her nest and flew straight to it. Her treasures were found.

In that moment did she cease to be a machine, and show a spark of free intelligence? It looks so at

least. She acted like a rational being, she seemed at last to have got it into her head that the nest was no longer in the old place, and that she must look about her. I do not say that this is the true explanation of her conduct; it is rather putting one's self in her place. But how long it took the birds to break out of the rut of habit! It did not seem as if their intelligence were finally influenced; but as if their instincts had become discouraged or fatigued. They were not convinced, they were baffled. Of course you cannot convince an animal as you can a person, because there is no reason to be convinced, but you can make an impression, you can start the formation of a new habit. See the caged animal try to escape, or the tethered one try to break its tether, — how long the struggle continues! A rational being would quickly be convinced, and would desist. But instinct is automatic, and the reaction continues. When the animal ceases its struggles, it is not as the result of a process of ratiocination, — "this cage or this chain is stronger than I am, therefore I cannot escape," — but because the force of instinct has spent itself. Man, too, is more or less the creature of habit, but the lower animals are almost entirely so. Only now and then, as in the case of the mother bluebird, is there a gleam of something like the power of free choice.

Animal intelligence is like the figures and designs made in a casting; it is not acquired or much

changed by experience, while human intelligence is slowly developed through man's educative capacity. The animal is a creature of habits inherited and acquired, in a sense that man is not; certain things may be stamped into the animal's mind, and certain things may be stamped out; we can train it into the formation of new habits, but we cannot educate or develop its mind as we can that of a child, so that it will know the why and the wherefore. It does the trick or the task because we have shaped its mind to the particular pattern; we have stamped in this idea, which is not an idea to the animal but an involuntary impulse. That which exists in the mind of man as mental concepts, free ideas, exists in the mind of the animal as innate tendency to do certain things. The bird has an impulse to build its nest, not any free or abstract ideas about nest-building; probably the building is not preceded or attended by any mental processes whatever, but by an awakening instinct, an inherited impulse.

A man can be reached and moved or influenced through his mind; an animal can be reached and moved only through its senses.

The animal mind seems more like the mind we see manifested in the operations of outward nature, than like our own. The mind we see active in outward nature — if it *is* mind — is so unlike our own that when we seek to describe it in terms of our own,

ascribing to it design, plan, purpose, invention, rationality, we are accused of anthropomorphism, and science will not listen to us. Yet all we know of laws and principles, of cause and effect, of mechanics and dynamics, of chemistry and evolution, we learn from this outward nature. Through our gift of reason we draw out and formulate, or translate into our mental concepts, Nature's method of procedure. Shall we say, then, that Nature is rational without reason? wise without counsel? that she builds without rule, and dispenses without plan? is she full of mind-stuff, or does she only stimulate the mind-stuff in ourselves? It is evident that Nature knows not our wisdom or economics, our prudence, our benevolence, our methods, our science. These things are the result of our reaction to the stimulus she affords, just as the sensation we call light is our reaction to certain vibrations, the sensation we call sound is the reaction to other kinds of vibrations, and the sensation we call heat, the reaction to still other. The mind, the reason, is in us; the cause of it is in Nature.

When we translate her methods into our own terms, we call it the method of "trial and error," — a blind groping through infinite time and infinite space, till every goal is reached. If her arch falls, a stronger arch may be formed by its ruins; if her worlds collide, other worlds may be born of the collision; if one species perishes, other species may

take its place; always if her "bark sinks 't is to another sea." She is all in all, and all the parts are hers. Her delays, her failures, her trials, are like those of a blind man who seeks to reach a particular point in an unknown landscape; if his strength holds out, he will finally reach it. Nature's strength always holds out; she reaches her goal because she leaves no direction untried.

She felt her way to man through countless forms, through countless geological ages. If the development of man was possible at the outset, evolution was bound to fetch him in time; if not in a million years, then in a billion or a trillion. In the conflict of forces, mechanical and biological, his coming must have been delayed many times; the cup must have been spilled, or the vessel broken, times without number. Hence the surplusage, the heaping measures in Nature, her prodigality of seed and germ. To produce one brook trout, thousands of eggs perish; to produce one oak, thousands of acorns are cast. If there is the remotest chance that our solar system will come in collision with some other system, — and of course there is, — that collision is bound to occur, no matter if the time is so distant that it would take a row of figures miles in extent to express it.

I am aware that it is my anthropomorphism that compels me to speak of Nature in this way; we have to describe that which is not man in terms

of man, because we have no other, and thereby tell a kind of untruth. It is as when we put bird-songs or animal-calls into words, or write them on the musical scale, — we only hint what we cannot express.

I look out of my window and see the tide in its endless quest, racing up and racing down the river; every day, every night, the year through; for a thousand, for a million years it goes on, and no one is the wiser, yet the tides have played their part in the history of the globe. But Nature's cradle keeps rocking after her child has left it. Only the land benefits from the rain, and yet it rains upon the sea as upon the land. The trees ripen their fruits and their nuts whether there is any creature to feed upon them, or any room to plant them, or not. Nature's purpose (more anthropomorphism) embraces the all, she covers the full circle, she does not need to discriminate and husband her resources as we do.

> "Far or forgot to me is near;
> Shadow and sunlight are the same;
> The vanished gods to me appear;
> And one to me are shame and fame."

The animals are so wise in their own way, such a success, without thought yet so provocative of thought in us! They are rational without reason, and wise without understanding. They communicate without language, and subsist without force-

thought. They weave and spin and drill and bore without tools, they traverse zones without guide or compass, they are cunning without instruction, and prudent without precept. They know the ends of the earth, the depths of the sea, the currents of the air, and are at home in the wilderness. We ascribe to them thought and reason, and discuss their psychology, because we are anthropomorphic; we have no other standards than those furnished by our own nature and experience.

Animal behavior, as I have said, is much more like the behavior of natural forces than is that of man: the animal goes along with Nature, borne along by her currents, while the mind of man crosses and confronts Nature, thwarts her, uses her, or turns her back upon herself. During the vast æons while the earth was peopled by the lower orders alone, Nature went her way. But when this new animal, man, appeared, in due time Nature began to go his way, to own him as master. Her steam and her currents did his work, her lightning carried his messages, her forces became his servants.

I am not aware that any animal in the least degree confronts Nature in this way — cuts its paths through her, and arbitrarily shapes her. Probably the nearest approach to it is among the insects, such as the balloon-spiders and the agricultural ants. In some parts of the country one might think that the cow was a landscape gardener from the

pretty cone-shaped forms that she carves out of the wild apple and thorn trees, but she does this quite unwittingly through her taste for the young shoots of these trees. It is like her engineering skill in laying out paths, quite inevitable from the nature of her wants and activities.

Man is the only inventive and tool-using animal, because he alone has the faculty of reason, and can see the end of a thing before the beginning. With his mind's eye he sees a world hidden from the lower orders. There are hints of this gift in the lower orders, hints of reason, of language, of tool-using, and the like, but hints only.

The cries and calls of animals must have preceded human speech, but who can measure the gulf between them? Man must have had animal emotions — fear, hunger, joy, love, hate — long before he had ideas. His gift of language and his gift of ideas must have grown together, and mutually reacted upon one another. Without language could he possess ideas, or possess ideas without language? Which was first?

An animal's use of signals — warning signals and recognition signals, if this is the true significance of some of their markings — is as unwitting as the flower's use of its perfume or its colors to attract insects. The deer flashes its shield to its foe as well as to its fellow.

How convincing it is that a monkey has no power

of thought and does not use its brain as we do, when we see one unable to obtain a banana placed just beyond its reach, though a tool in the shape of a small rake be placed in its hand! It is hungry for the fruit, and were it within reach of its own arm, it would quickly seize it, but the artificial extension of the arm by means of the rake, it has not the wit to avail itself of. It cannot use a tool. Its keeper takes hold of its hand, holding the rake, and shows it how to get the fruit; he repeats the act over and over, and yet the monkey left to itself does not use the rake. Its poor little noddle is too small or too dark to take in even so trifling a conception as that; it cannot form the simplest idea. If it learns finally to use the rake, it does it in an automatic way, it does not see why it should use the rake, it does not perceive any relation between its hand and the rake and the fruit. Poor thing! one thinks of its skull as pressing down close upon its brain, leaving not the least room for ideas.

When an animal has a special tool in its organization, its whole life centres in and revolves about that tool. I used to sit on a balcony in southern California day after day and see the native brown thrasher digging up the lawn or the garden with that long hooked beak of his. He uses it like a pick-axe, and he can make the turf and soil fly. He does nothing else while he is in my sight. "Give me a place to dig, to use my tool," he seems to say

each moment. Other birds are scratchers or probers or drillers, and they are under the tyranny of their organization in the same way. The hog must root, the hawk must strike, the skimmer must skim. It is a hampering thing to have one's tools and weapons a grown part of one's self, but the advantage is that one does not have to be taught how to use them.

III

Considering the gulf that separates man from the lower orders, I often wonder how, for instance, we can have such a sense of companionship with a dog. What is it in the dog that so appeals to us? It is probably his quick responsiveness to our attention. He meets us halfway. He gives caress for caress. Then he is that light-hearted, irresponsible vagabond that so many of us half-consciously long to be if we could and dared. To a dog, a walk is the best of good fortunes; he sniffs adventure at every turn, is sure something thrilling will happen around the next bend in the path. How much he gets out of it that escapes me! — the excitement of all the different odors that my sense is too dull to take in. The ground to him is written over with the scent of game of some sort, the air is full of the lure of wild adventure. How human he is at such times! he is out on a lark. In his spirit of hilarity he will chase hens, pigs, sheep, cows, which ordinarily he

would give no heed to, just as boys abroad in the fields and woods will commit depredations that they would be ashamed of at home.

When I go into my neighbor's house his dog of many strains, and a great crony of mine, becomes riotous with delight. He whines with joy, hops upon my lap, caresses me, and then springs to the door, and with wagging tail and speaking looks and actions says, "Come on! let's off." I open the door and say, "Go, if you want to." He leaps back upon my lap, and says, "No, no, not without you." Then to the door again with his eloquent pantomime, till I finally follow him forth into the street. Then he tears up the road to the woods, saying so plainly, "Better one hour of Slabsides than a week of humdrum at home." At such times, if we chance to meet his master or mistress on the road, he heeds them not, and is absolutely deaf to their calls.

Well, I do not suppose the dog is in our line of descent, but his stem-form must join ours not very far back. He is our brother at not very many removes, and he has been so modified and humanized by his long intercourse with our kind, stretching no doubt through hundreds of thousands of years, that we are near to him and he is near to us. I do not suppose, if this affectionate intercourse were to continue any number of ages or cycles longer, that the dog would ever be any more developed on his in-

tellectual side; he can never share our thoughts any more than he does now. He has not, nor have any of the lower orders, that which Ray Lankester aptly calls educability, that which distinguishes man from all other creatures. We can train animals to do wonderful things, but we cannot develop in them, or graft upon them, this capacity for intellectual improvement, to grasp and wield and store up ideas. Man's effect upon trained animals is like the effect of a magnet upon a piece of steel: for the moment he imparts some of his own powers to them, and holds them up to the ideal plane, but they are not permanently intellectualized; no new power is developed in them; and they soon fall back to their natural state. What they seem to acquire is not free intelligence that they can apply to other problems. We have not enlarged their minds, but have shaped their impulses to a new pattern. They are no wiser, but they are more apt. They do a human "stunt," but they do not think human thoughts.

IV

In all the millions of years that life has been upon the globe, working its wonders and its transformations, there had been no bit of matter possessing the power that the human-brain cortex possesses till man was developed. The reason of man, no matter how slow it may have been in finding itself, was a new thing in the world, apparently not contem-

plated by Nature's plan, as, in a sense, it is at war with that plan, and a reversal of it.

Just as life was a new thing in the inorganic world, contravening the ordinary laws of matter, expressing a kind of energy not derived from gravitation, making chemical and physical forces its servants, so was the reason of man a new thing, evolved, of course, from preëxisting conditions, or animal automatism, but, when fairly differentiated, a new mode of energy, making its possessor a new kind of animal, reversing or annulling many of the laws that have sway in the rest of the animal kingdom, defeating the law of natural selection and the survival of the fittest, rising superior to climate and to geographical conditions, controlling and changing his environment, making servants of the natural forces about him; in short, fairly facing and mastering Nature in a way no other animal had ever done.

The conditions that have limited the increase and spread of the other animals have been in a measure triumphed over by man. The British scientist I have quoted above, Ray Lankester, has described man as Nature's rebel — he defies her and wrests her territory from her. "Where Nature says, 'Die!' man says, 'I will live.' According to the law previously in universal operation, man should have been limited in geographical area, killed by extreme cold or heat, subject to starvation if one

kind of diet were unobtainable, and should have been unable to increase and multiply, just as are his animal relatives, without losing his specific structure and acquiring new physical characters according to the requirements of the new conditions into which he strayed — should have perished except on the condition of becoming a new morphological species."

All this because man in a measure rose above the state of automatism of the lower orders. His blind animal intelligence became conscious human intelligence. It was a metamorphosis, as strictly so as anything in Nature. In man, for the first time, an animal turned round and looked upon itself and considered its relations to the forces outside of self; in other words, it began to speculate and inquire and ask the why and the wherefore of things. It paused to consider; it began to understand. This self-awareness distinguishes man from all other animals and is the secret of his enormous development.

The mechanism called instinct gave place slowly to the psychic principle of reason and free will. Trouble began with the new gift. This was the real fall of man, a fall from a state of animal innocence and non-self-consciousness to a state of error and struggle; thenceforth man knew good from evil, and was driven out of the paradise of animal innocency. Reason opened the door to error, and in the same moment it opened the door to progress. If

failure became possible, success also became possible. The animal with his instincts was doomed to a ceaseless round of unprogressive life; man with his reason had open to him the possibility of progressive mastery over Nature. His race-mind developed slowly, from period to period, going through an unfolding and a discipline analogous to that of a child from infancy to manhood: many failures, many sorrows, much struggle; but slowly — oh, so slowly! — has he emerged into the light of reason in which we find him now. The price the lower animals pay for unerring instinct is the loss of progress; the price man pays for his erring reason is the chance of failure.

Man's mastery over Nature has made him the victim of scores of diseases not known to the animals below him. The artificial conditions with which he has surrounded himself, his material comforts, his extra-natural aids and shields, have opened the way to the invasion of his kingdom by hosts of bacterial enemies from whose mischievous activities the lower orders are exempt. He has closed his door against wind and cold, and thereby opened it to a ruthless and invisible horde. Nature endows him with reason, and then challenges it at every turn. She puts a weapon into his hand that she has given to no other animal, and then confronts him with foes such as no other animal knows. He pays for his privileges. He has entered the lists as a free

lance, and he must and does take his chances. For the privileges of mastering certain of Nature's activities, he pays in a host of natural enemies. For the privilege of fire, he pays in the hazard of fire; for the privilege of steam, he pays in the risks of steam; for knowing how to overcome and use gravity, he pays in many a deadly surrender to gravity. He shakes out his sail to the wind at the risk of the wind's power and fury. So always does the new gift bring new danger and new responsibilities.

Man is endowed and blest above all other creatures, and above all other creatures is he exposed to defeat and death. But the problem is not as broad as it is long. The price paid does not always, or commonly, eat up all the profit. There has been a steady gain. Nature exacts her fee, but the service is more than worth it. Otherwise man would not be here. Unless man had been driven out of Paradise, what would he have come to? The lower orders are still in the Garden of Eden; they know not good from evil; but man's evolution has brought him out of the state of innocence and dependence, and he is supreme in the world.

VII

NATURE AND ANIMAL LIFE

HOW surely every drop of water that sees the light in the most remote mountain or forest recesses finds its way to the sea, if not in some way intercepted! How surely the springs collect into rivulets, the rivulets into brooks, the brooks into creeks, the creeks into rivers, and the rivers sooner or later find their way to the great ocean reservoir! Dip up a cup of water from the little mountain rill and ask it whither it is going, and if it could reply it would say: "I am going to the sea; I have no choice in the matter. I am blind, I have no power of self-direction, but my way is appointed, and I know that sooner or later I shall reach the great deep." It seems as if some engineer had planned and shaped the face of the landscape and of the continent with this very end in view. But the engineer was the water itself. Water flows downhill; that settles it. It is all the inevitable result of natural law. Neither the lives of men nor those of the lower animals escape the action of similar universal laws; especially are the lower animals under their dominion.

In the first place, the activities of all creatures

are largely determined by their organization. This appoints the bird to fly, the fish to swim, the snake to glide, and man to walk and stand erect. It appoints the woodpecker to bore or drill the trees, the snipe to probe the mud, this kind to catch insects, that one to catch fish, this one to live on seeds or fruit, the other to prey upon game, and so on.

Now, the so-called intelligence of the lower animals is largely like that of the rills that find their way to the sea, or of the seeds of the plants that find their way to their proper habitat. Marsh plants find their way to the marshes, hill plants find their way to the hills. The spores of the black knot seem to hunt out every plum-tree in the land. The rats and the mice find their way to your new house or new barn, because they are constantly on the search for new fields. The squirrels find the acorn-grove and the birds the cherry-trees for the same reason. Their necessities for food send them in all directions till they hit the right spots.

Nature plays the principal part in the lives of all creatures, man included, supplying motives, impulses, opportunities, the guidance of organization, the inheritance of instinct, the stimulus or the check of environment, the bent of race, family, temperament, the lure of plenty, the bar of scarcity, the potency of soil, climate, geography. The birds come north when a warm wave brings them; the

shad run up the rivers when the south wind blows them up; the hibernating animals come out of their retreats when the warmth awakes them.

The play of will and conscious intelligence inside the limitations of Nature is considerable in man, very little in the lower animals.

The bird builds a nest, not because it thinks nest, and plans nest, and sees the end from the beginning, as man does when he builds a house, but because the great Mother Nature in which it is embosomed and which is active in the bird thinks nest for it — and impels it to the construction. The bird is the instrument of the propagating impulse which pervades Nature, as is man himself up to the point where his own individual judgment and volition come into play, which, it must be confessed, have only a narrow field to work in. The beaver in building its dam works as blindly, that is as inevitably and unconsciously — as free from individual initiative — as it does in developing its chisel-like teeth or its broad trowel-like tail. This inherent unconscious intelligence we call instinct, a faculty which is constant in its operation, and though not inerrant, is free from the vacillations and failures of human reason. It is analogous to that something in the plants which determines their forms, the color of their flowers, and their times and seasons. Instinct is sometimes abortive; so do plants sometimes fail of their colors and fruit.

All the larger movements of humanity are probably as much the result of the operation of natural law as are the movements of the animals. A man feels free to choose this or that, to emigrate or stay at home, to undertake this or that enterprise or to let it alone; yet that which finally determines his course, influences his will, is quite beyond the reach of his will or his consciousness. He does certain things because he is of a certain race and family, because he lives in a certain age and country, because his hair is red or black, because his health is good or bad. He is a Democrat or a Republican because his father was so before him. He is skeptical because he lives in a skeptical age; he is a fanatic because he is surrounded by fanatics; he wears a derby hat because all his neighbors do; he gesticulates because he is a Frenchman; he growls because he is an Englishman; he brags because he is an American. The many influences that work over his head and under his feet, and that stream upon him from all sides, are all unknown to him.

The animals are all so wise in their own sphere, the sphere of instinct, in doing the things that they have to do in order to survive and perpetuate the species, that one is always astonished at their stupidity outside that sphere when a new problem presents itself; as when a robin and a phœbe each built three or four nests on a timber under a porch, because there were three or four places in a row just

alike, and the bird could not distinguish between them or concentrate herself upon one spot. The nesting instinct in each case was so strong that the bird had not a particle of sense apart from it. Something impelled it to build, build, and it put down its load of mortar or straws at whichever point it chanced to hit. It was a hit-or-miss game surely. Such incidents give us a glimpse of how absolutely under the dominion of natural impulses animal life is, especially at certain times. The breeding instinct with nearly all creatures becomes a kind of intoxication, a frenzy, and if the bird, with all its cleverness, is ever a fool, it is a fool then. On different occasions I have seen a robin, a bluebird, and a blue jay, in nesting-time, each dashing itself against a window in which it saw the reflection of its own image, thinking it was demolishing or just going to demolish a rival. Hour after hour, and day after day, the bloodless farce went on, till the bird finally dêsisted, apparently not because it saw it was the dupe of its own jealousy, but from sheer exhaustion. How like blind inanimate Nature such things are! like the winds and the waves in their unintelligent fury. An animal never sees through appearances; things are what they seem to him, and a piece of paper or an old hat by the roadside is a fearsome thing to a nervous horse. Nature has heaped the measure of their caution and fear, that they may be sure to escape their real enemies, and she has heaped the

measure of their propagating instincts to make sure that the species do not fail.

How clever, too, they are about their food! They *have* to be or else starve. No doubt many of them have starved in the past, and only the clever ones survived and so continued the species. When one sees the birds in spring scouring about for food where apparently there is no food, or thinks of the mice and squirrels and foxes in the barren, desolate, snow-choked woods, or of the thousands of crows in winter going to and fro night and morning in quest of forage, one realizes how acute and active and discerning they must become to survive at all. Just how the robin knows the precise spot in the turf on the lawn to dig in order to strike a fat grub, I do not know, but he rarely fails. I am sure that I could not pick out the spots. But my dinner is not contingent upon that kind of acuteness; if it were, no doubt I could quickly learn the secret, too. The red squirrel, no doubt, learned that the sap of the maple was sweet long before the Indian or white man did. How surely he finds out in May when the seeds of the elm-tree will afford him a tiny morsel! He is hard-pressed for food at this time and will take up with very short pickings. I saw one a few moments ago getting his breakfast in an elm near my cabin. How eager and hungry he appeared to be, how rapidly he chipped up or opened the flake-like samaras of the tree and devoured the minute

germ which they held! He would hold to a branch by his hind feet, and reach far down to the ends of the pendant twigs for the clusters of fruit. A squirrel's hind feet are especially adapted for hanging in this way. Mr. Hornaday says the pika, or little chief hare, in the Canadian Rockies cuts and gathers various grasses and plant-stalks, and cures them in the sun beside the entrance to its den, and then stores them up for winter use. He says that if, during the day, the shadow of a rock falls upon the curing hay, the pika moves it out into the sun again. Another authority says that it will also make haste to house its hay if a shower threatens. These last acts seem almost incredible. I should like to have a chance to verify them. In any case we see in the habits of this creature another proof that an animal will and can learn to live, and in the struggle may develop an instinct that closely simulates human intelligence. Simulates, I say; we can hardly call it the same, though it reaches the same end by the same means. It is not to be supposed that the individual pika knows the value of curing grass before storing it away, as we know it from experience and observation, or that it takes any thought about the matter. The race of pikas knows it as an inherited trait. It is the wisdom of Nature and not of the individual pika. I suppose the habits of the wild creatures generally in laying up their winter stores are as far removed from conscious thought and

purpose as is the storing-up of fat in our bodies an unconscious process. Life in all its forms adapts itself to its conditions; else it would not be life; it would cease. Only in man is this adaptation ever a matter of thought and calculation, and in him only in a minor degree. The climate, the geography, the geology, the race, the age, all play a part in moulding and making him.

Over all and under all and through all is the universal intelligence, the cosmic mind. It is that which determines and shapes, humanly speaking, all the myriad forms of the universe, organic and inorganic. Only in the higher forms of animal life is the cosmic mind supplemented by conscious, individual intelligence. There are occasional gleams of this intelligence in the lives of the lower animals, but not till we reach man does the spark become a flame. Man's wit differs from the wit of universal Nature in that it plays inside the latter and has a certain mastery over it and works to partial and personal ends. We call the cosmic mind blind; it is rather impersonal and indirect. All ends and all means are its, and it fails of no end because it aims at none. How can a circle have an end? It returns forever into itself. Suns and systems and races and men are but the accidents, so to speak, of its universal activity. Man sees the end of his efforts because they are limited to his personal wants and aspirations. But Nature's purpose embraces all. Her clock is not

wound up for a day, or a month, or a year. It was never wound up, and it will never run down, and it strikes only the hours of eternity. But here I am in deep waters, quite over my head. Follow any of these little rills of natural history and they will lead you sooner or later to larger questions and thence to the boundless sea.

The adaptiveness of animal life, and one may say of vegetable life also, is a subject of deep interest.

In the dry streamless valleys on Cape Verde Islands, Darwin saw a kingfisher that lived on grasshoppers and lizards, diving for them in the true kingfisher fashion. Doubtless our own kingfisher, under the force of circumstances, might adapt himself to such a mode of life.

The beasts and birds that are most adaptive in the matter of food thrive best. If the quail could learn to subsist upon tree-buds as does the grouse, it would not perish as it now does during our winters of deep snow. What a success the crow is! And to what does he owe it more than to his adaptiveness in regard to food? Grain, nuts, worms, insects, fish, frogs, eggs, grubs, mice, and things still more unsavory — each and all help him through the season. The hawks are restricted to flesh alone, hence their comparatively limited numbers.

I suppose we always attribute much more thought and purpose to the animals than they are capable of. We do not realize what automatons they are.

Much of their activity is the result of their organization, and very little the result of free choice, as with man, — though in the case of man what he calls his "free choice" is no doubt largely determined by forces and conditions of which he is not conscious.

I notice that the nests of the orioles are longest and deepest where they are the most pendant, that they are deeper and more pocket-like on the willows and elms than on the oaks and hickories, and that they are the shallowest of all on stiff young maples where they are usually placed near the stem of the tree. In such cases they are shallow and cuplike. The longest nests I see near me are on the weeping willows. Now if this observation holds true, the natural inference would be that the birds considered the matter, and that they knew that the more pendant the nest the greater the danger to eggs and young during high winds; therefore, in certain situations they build deeper than in others. But I cannot make myself believe that the birds take any thought about the matter at all. The simplest explanation of their course seems to me to be this: In the act of building their nests they would be swayed more or less by the winds — more upon the willows and elms than upon trees of stiffer branches like oaks and maples. This greater swaying would stimulate them to build deeper nests; it would be the condition that would bring their pendant-nest in-

stinct into greater activity. A still simpler explanation is the suggestion that this instinct is feebler in some birds than in others, and is feeblest of all in those birds that build cup-shaped or basket-shaped nests on stiff young maples newly planted by the roadside. We are not to ascribe to an animal a process of reasoning so long as there is a simpler explanation of its conduct.

When we have an early spring we plant and sow early, and *vice versa*. We seem to think that the birds choose to act similarly, and to nest early or late as their judgment as to the weather prompts. But they have no choice in the matter. A warm wave brings them, and a cold wave retards them, as inevitably as it does vegetation. The warmth stimulates them to nest-building, for the reason that it increases their food-supply; the more warmth the more food, and the more food, the more rapidly the egg develops in the mother bird. Heat hastens the ripening of the egg as surely as it hastens the ripening of fruit, and cold retards it to the same extent. In cold, backward springs I note that the robin lays only two or three eggs in the first nest; in warm seasons she lays four or five.

Pluck off the leaves of a tree in the early season and new leaves will form; sometimes new blossoms will come a second time. Rob a bird of her eggs and she will lay another clutch, and still another, till the season is past. I suppose that there is no more of

deliberate purpose in the one case than in the other. A wild plant's one thought, one ambition, is to mature its seed. When it starts in the spring it has the whole season before it, and it runs the stalk up to its full stature; but if it gets a late start its abbreviated stalk seems like an act of conscious intelligence; it must hasten with its seed before the season passes. The second or third nest of a bird in spring is usually a much more hasty affair than the first. The time is precious, and the young must not get too late a start in life.

I fancy that to all human beings the spring gives an impulse toward new fields, new activities, that is quite independent of any will or purpose of their own. We are all children of one mother after all and are tied to her apron-strings. The pulse of the life of the globe is felt alike in all of us, feeble or strong. Our power of will, of purpose, carries but a little way against the tendencies of race, of climate, of the age, or the tides of the seasons.

I have often asked myself if we should count it an act of intelligent foresight in the birds when they build their nests near our houses and roadways, apparently seeking the protection from their enemies which such places are supposed to afford. I have concluded that the idea of protection does not influence them any more than it does the rats and the mice that infest our houses, or the toads that lurk under our porch floors. How should a robin, or a

phœbe, or a bluebird, or any other bird, know that its enemies are less bold than itself and dare not venture where it ventures? These birds are all more or less afraid of man and tolerate his presence under protest, and it is probably true that the dangers to which they are exposed in nesting near us, from cats, rats, mice, and boys, are as great or greater than they would be from wild enemies in remote fields and woods. Birds seek the vicinity of man because food in the way of insects, seeds, and fruits is more abundant, and because the shelter which some of them seek is better and more extensive. I think the oriole is attracted by the abundance of nesting material — strings and horsehairs; and the swallows for the same reason — mud and feathers. All birds instinctively seek to hide their nests, and even porches and sheds and bridges afford cover and hiding for the robins and phœbes, to say nothing of the better foraging upon the lanes and in the garden and the cherry-trees for the robins, and in the air about the buildings for the phœbes. The kingbird likes to be near the beehives, for he is fond of the drones; and the chippy comes to the rose-bush, or the lilac-bush, or the near apple-tree, because she likes crumbs from the table and the meal the chickens leave. I notice that the birds build in or about deserted houses nearly as freely as about those that are occupied. All birds that build in holes and cavities can be attracted by putting up

suitable boxes and houses for them to nest in. In this way you can attract bluebirds, house wrens, and purple martins.

In certain respects the birds are much like the weeds. Certain weeds follow our footsteps and thrive best near us; they fatten on our labor. So do certain species of birds follow us, not for protection but for better shelter and better fare. Surely the English sparrow does not dog the footsteps of man for any fancied protection. The wood thrush as I know it seems to love civilization; he doubtless finds his favorite food more abundant in the vicinity of our dwellings. His cousins, the hermit and veery thrushes, prefer the dense, remote woods, and doubtless for the same reason. The wood thrush's brighter coat seems more in keeping with the open glades and groves than with the denser woods.

The paramount question with bird and beast, as with us, is always the question of well-being. We consider the matter, we weigh the pros and cons, and choose our course, as we think, according to reason. But the animals are prompted and guided by outward conditions, — the season, the food-supply, their nesting needs, and so forth. Of course primitive man is largely influenced by the same considerations; his necessities determine his course.

It is interesting to note how certain insects behave like natural forces. Watch the growth of the paper nest of the hornet; see it envelop the obstacles

in its way, — leaves and twigs, — precisely as a growing tree might, or as flowing water does. I saw two nests of yellow-jackets in the side of a house, built in the space between the siding and the inner wall; and these nests flowed out of the cracks and nail-holes in the clapboards in thin sheets, just as any liquid would have done. Narrow gray films were pushing out here and there, over a space of several square feet. The hornets had filled the space inside with their nest and had reached the limit, but they did not know it, and kept on building as long as the season prompted.

The strongest instinct in the carnivora is the killing instinct, and when this instinct is fully aroused does the animal know what it is doing? When a weasel or a wildcat gets into your hen-roost, it rarely stops till every chicken is killed, though it may not devour one of them. We say it kills and kills to satisfy its lust for blood, as the inebriate drinks and drinks to satisfy his abnormal appetite for alcohol. But it is not like that. The weasel or the mink kills all within its reach in obedience to its normal killing instinct. It has no choice in the matter. Appetite starts the machine and then it keeps on and on like a fire. Last winter a wildcat, starved to mere skin and bones, was found at midday in the henhouse of one of my neighbors. It had killed over thirty hens and kept on with the slaughter while the man ran to the house for his gun. The strange part

of the incident is that it had not eaten one of the fowls or any part of one that it had killed. The explanation doubtless is that its killing instinct was so overstimulated by its great hunger that the cat could do nothing but kill as long as there was a live fowl left. There was no such word as enough in its vocabulary. It had no perception of the relation between its appetite and any given quantity. It must kill and kill and kill again. After it had cleared the roost, if left alone, it would doubtless have fallen to and gorged itself. Wolves act in a similar way with a flock of sheep, killing vastly more than they can eat. I do not look upon this excess as the result of the wild spirit of debauch, in the human sense, but as the result of blind instinct acting automatically. The rodents that hoard nuts illustrate the same tendency. A tame chipmunk, fed to repletion, will hoard all the nuts you have a mind to give him, and go through the pantomime of covering them up on the bare floor of an empty room. Dallas Lore Sharp says a red squirrel will hoard nuts in its own cage from the stores you give it, and that if a white-footed mouse were confined in a room with a peck of hickory-nuts, it would make little piles of the nuts about the room.

We marvel at what we call the wisdom of the hive bee, yet there is one thing she never learns from experience, and that is, that she is storing up honey for the use of man. She could not learn this,

because such knowledge is not necessary to her own well-being. Neither does she ever know when she has enough to carry her through the winter. This knowledge, again, is not important. Gather and store honey as long as there is any to be had, is her motto, and in that rule she is safe.

VIII

THE KEY TO ANIMAL BEHAVIOR

IF I were to give a detailed account of the tide of wild life that ebbs and flows, winter and summer, about my cabin door, of the shrike I saw a few days ago hunting a little brown creeper about the trunk of the maple-tree in front of my window, and especially of the downy woodpecker that has been excavating a chamber for his winter-quarters in the top of a chestnut post in the vineyard near my study, hammering away at it day after day like a carpenter building a house, and returning there at night after his day's work and his foraging for supper are over — if I were to give a detailed account of these things and others, many of the incidents would show so much of what we in ourselves call rational intelligence that we should be tempted to ascribe the same powers or faculties to these wild neighbors of mine. Intelligence we may call it without falling into any very serious anthropomorphism — the kind of intelligence that pervades all nature, and which is seen in the vegetable as well as in the animal world, but which differs radically, in its mode of working, from rational human intelligence.

A more specific name for it, and a better one, I think, and for all similar behavior on the part of bird and beast, is the ancient and honorable term "instinct" — a term that the "new psychology" is beginning to shy at or openly to repudiate, but which I do not see how we can get along without.

Take the case of the woodpecker and his retreat. It may well be the first cavity of the kind the bird has ever made or occupied, but its forebears have made and used such cavities for untold generations, and Downy unconsciously remembers it all. The whole proceeding is very human, very like what a person might do under certain circumstances — build a hut at the approach of winter, or take possession of one already built, enlarging and changing it to suit his notions, and be on the alert for his enemies while thus engaged. Yet we do not, because of this, ascribe reason to the woodpecker, or conscious forethought; we call it instinct, inherited memory. In a man these and similar acts are attended with more or less reflection and conscious exercise of will, with, no doubt, much instinctive or inherited impulse.

Now the new laboratory psychology comes along and says that the key to animal behavior is neither reason nor instinct, but habit or experience. I have in mind especially two recent papers in one of the popular magazines,[1] in which the writer urges that

[1] See *McClure's Magazine* for June and August, 1909.

the lower animals not only do not reason, — which is just what I have been preaching myself, in season and out of season, for some years past, — but that, with adult animals of the more intelligent species, pure instinct, so far from being a controlling factor in the creature's life, hardly has to be reckoned with at all — which is just the opposite of what I have been preaching. The animal, our writer urges, "forms habits precisely as we do, and, precisely like ourselves, stores up, as habits, many common experiences of life." My own contention is that the wild animals act mainly from inherited habits or instinct, and that their acquired habits, "so far from being a controlling factor in the creature's life, hardly have to be reckoned with at all."

How the writer explains the conduct of animals that have had no chance to store up experiences and form habits — the bird building its first nest, the hen with her first brood of chickens speaking a language she never before spoke, and her young understanding a language they never before heard, the heifer hiding her first calf in the bush, the ground-bird decoying you away from her first nest by fluttering over the ground as if half-disabled, the puppy burying its first bone, perhaps on the carpet or the kitchen floor, the chipmunk or the wood-mouse laying up its first store of nuts, and a score of other primary acts of the animals, which they never could have learned as we learn, and

which they do offhand the first time the occasion arises — how the writer explains all these things, I say, I am at a loss to know.

These instincts or native impulses, as they are passed along down the line of animal descent, are slightly modified now and then, but remain practically the same from generation to generation. The cliff swallows have built their nests of mud — how long? The chimney swifts have built theirs of twigs — how long? The brooding grouse, when started from her nest, has feigned lameness and paralysis — how long? The beaver has been building its dam of sticks and mud — how long?

The word "instinct" is of metaphysical rather than of scientific origin, but it means so much more than reaction or tropism that we cannot dispense with it. It marks off the animal world from the human almost as distinctly as the animal is marked off from the vegetable. It covers all the animal behavior that is independent of experience, and that an animal does perfectly when the first occasion for it arises. In the orders immediately below man nine tenths of the actions of the animals are the result of involuntary inherited impulse. The other tenth may be the result of experience or acquired habit.

A large fraction of our lives also is the result of inborn inherited impulses or tendencies, but these are constantly checked and controlled by reason and experience. An animal never checks its natural

impulse unless we train it to do so or drill it into new habits. A man has an impulse to steal or to murder, to over-eat or to run away from danger; but he checks the impulse, because he is a man and not a dog.

Each animal species inherits an organization that determines the kind of life it shall live, how it shall meet its enemies, how get its food and what that food shall be, its habitat, and the like, and it inherits the instincts that go with the organization. The porcupine knows how to use its quills, the skunk its essence, the hawk its talons, the cuttlefish its ink, without previous experience or instruction — that is, instinctively. The mole takes to the ground and is lost on the surface. His organization makes him a prisoner of the soil. Call his behavior instinctive or a tropism or what you will, it is innate, and is not a habit acquired by the individual mole, but by the race of moles.

Man's organization is not specialized in anything like the same degree as that of his animal kin. He inherits no weapons, either of offense or defense; he is confined to no habitat or clime; he is restricted to no special food. He is a tool-maker and inventor, and arms and equips himself with a thousand external things and forces. He is a learner, an acquirer of knowledge. He has legs with which to walk, but he has to learn to walk as much as he has to learn to skate or to swim or to ride a bicycle. He

is born with vocal cords and organs of speech, but he has to invent his own language and music. The animals, on the other hand, do not have to learn to walk or swim or fly or speak. If these acts are appropriate to their kind, they do them naturally. The lamb and the calf walk, the duck swims, the snake strikes, the hour they are born.

Man is a generalized type, except as regards his brain-power. He is not by his anatomy a climber, or a swimmer, or a wader, or a flyer; he has neither fangs, tusks, talons, horns, spurs, nor claws. And yet, by virtue of his gift of reason, he does all of these things — provides himself with tools that serve all these purposes and many more. It is his reason, and not his instinct, that places him so far above all other animals. A man with skates on his feet is like one of the lower animals in this respect: he is specialized, his range is limited. If he were born with such a device on his feet, he would have an instinct for skating; or if he had a nose like a pig, he would have an instinct for rooting; if he had feet like a goose, he would have an instinct for swimming. Man's organization and brain-power is such that pure instinct plays a far smaller part in his life than it does in the lives of the animals below him. He has general instincts, while they have special instincts; he checks and controls or suppresses his instincts by his reason, which the animals never do. A man may have more instincts than his dog or his

horse or his ox, but how wide of the mark it would be to say that he is under the dominion of his instincts as these animals are under the dominion of theirs!

We are all more or less the creatures of habit, but of acquired habits rather than inherited habits. Man has filled the world with his acquisitions, and changed the face of continents with the tools he has invented. He performs hardly an action that is not the result of some acquired habit or for which he does not draw upon some acquired or stored-up power. Nature gave him the power to make sounds, but his language, his music, he has invented; she gave him the power to walk, but his power to sail, to fly, to cross continents faster than the fleetest horse, he has given himself; she gave him the power to hurl a stone or a spear or a club; but the power to hurl tons of metal miles upon miles, he has given himself.

What the wild creatures shall do, where they shall live, what they shall eat, is determined, I repeat, by their organization. Acquired habit or experience modifies the natural course of their lives very little. The scarcity of their staple food may drive them to an unaccustomed diet, as when the crossbills from the north fell upon the peach orchard in my neighborhood one May and cut out the germ of the peach blossoms. Hunger will drive a fox to eat corn which he cannot digest, or fear of the mongoose will drive rats to nest in trees.

With our domestic animals the case is different; they are useful to us mainly on account of their acquired habits. We have trained them to do our bidding. The horse in the harness or under the saddle, the ox in the yoke or hitched to the plough or the cart, the dog trained to point, to retrieve, to trail, the performing animals in the circus or in the menagerie, all act from acquired habits. Their natural instincts have been eradicated or greatly modified. We have trained them to our own wills, as we train a tree to some arbitrary pattern. If let alone a few years, the clipped tree will go back to its natural form; the domestic animal, if given a chance, quickly reverts to the state of its wild brothers. Man himself, in war, in camps in the woods, or among the mines, tends to revert to a state of barbarism.

In calling instinct inherited habit we do not, of course, clear up the mystery. Perhaps we only substitute one mystery for another. There remains the mystery of inheritance, which we think we can track to certain parts of the nucleus of the germ cell, and there our analysis stops.

The new psychology is confusing when it says, speaking through its magazine exponent, that there is no such thing as instinct, but "instincts there are by the score." There is no such thing as maternal instinct, it says, but only "impulses that have to do with young, which females possess and males lack"; no such thing as a homing instinct, but

only an attachment for some particular place to which the animal has learned the way. In short, "instinct is not a faculty but a reflex."

What men possess and share with the lower orders are impulses — involuntary, spontaneous impulses to do certain specific things; and this is what we mean by instinct. The "impulses that have to do with young, which females possess and males lack" — what is that but the maternal instinct? It is not acquired, it is latent in the female, and is developed when her young are born. In the insect world it is active before the young are born, and leads to solicitude about the young that the mother is never to see. There is the nesting instinct in birds, which is stronger in the female than in the male; the stalking instinct in the cat is stronger than it is in the dog. We form an idea of these various unconscious responses or reactions to external conditions, and we call it instinct.

Can we argue that there is no such thing as the mating instinct among animals, from the fact that it works differently in different species? There may not be such a thing as the "homing instinct," in the sense in which we used to believe there was in pre-evolutionary days — a blind impulse that carries an animal back home unerringly, and that acts independently of sight or sense. Though this is still a mooted point, I do not believe that a wild animal ever gets lost, though we know domestic ones do.

The domestic animal's instincts are by no means as sure in their action as are those of their wild brothers. But I do not believe that a wild animal finds its way home in the same way that a man does — by a process of calculation and judgment, and memory of familiar points. I have seen the murres in Bering Sea fly for many miles straight home to their rookeries through a dense fog; and the fur seals in the vast pathless wilderness of the Pacific find their way back each spring to their breeding-rocks in Bering Sea. I cannot see how their sense of sight or smell could aid them in such cases. President Roosevelt told me of a horse he had during his ranch days that returned to its old home, seventy miles away, by taking a direct line across the prairie, swimming rivers in its course. How did the horse know the way? Wild animals probably have a sense of direction that is enfeebled or lost in domestic animals — a sense that civilized man has lost also, but that is keen in barbarians.

The statement that young ducks have no instinctive impulse to enter the water is misleading. Why, then, do they enter it voluntarily? Young ducks have no instinctive recognition of water through the eye, but they have through the feet; the moment they feel the water with their feet, the impulse to enter is awakened, and away they go. Is this true of chickens? Neither ducks nor chickens know water through the sense of sight, but by the sense of touch.

Their drinking and swimming habits are simply reactions. The power must be directly applied to set the machinery going. This inherent tendency on the part of the duck to take to the water is instinct. The chicken does not take to the water when its feet are wet; it does not inherit the swimming impulse, and it cannot acquire it; its organization holds it to the land.

The kitten may not know a mouse at sight, but does this prove that it has not the killing instinct? The cat is a preying animal. It preys upon the small animals and birds and insects; and this is not a habit, but an instinct which you cannot eradicate. It is quite possible that a laboratory kitten would not kill a mouse offhand, but can any one doubt that the young of a wild cat would kill a mouse at sight?

Few mammals gain any knowledge through the eye. Often the dog does not know his own master by sight. The sense of smell is their guide; that alone is convincing to them; hence the keenness of this sense in most wild creatures.

The writer to whom I am referring says that "so far as the study of animal behavior is concerned, the days of the mere observer are past," — he has lost his job. The "new psychology" captures the animal, imprisons it in a cage like a culprit, and then begins its detective work. Certain things may, no doubt, be learned about animal mentality by this course; but I am very skeptical

about the amount of light that can be thrown upon the springs of animal life, at least upon the life of the higher vertebrates, by this inquisitorial proceeding. In the laboratory, or in any sort of confinement, the animal is placed in unnatural conditions, and the problems that confront it in captivity do not arise in the natural course of its life. Its instincts are demoralized because its body is restrained. Man is a disturbing influence. Animals under his care even change their colors. In laboratories their native wit is usually at low ebb, and they do not know what they do know. Their instincts are balked because of the strangeness of the environment. They are not themselves, and do not and cannot act out their true natures. What, for instance, could your new psychologist learn of the real life and character of my downy woodpecker by his laboratory experiments? Could he persuade him to excavate his winter lodge? Could he induce him to select a drum from a lot of dry limbs put in his cage, and, when the spring days come, begin his resonant hammering to attract a mate? Can the real instincts and the varied natural accomplishments of any of the wild creatures be brought out by this jailing process? I doubt it. Some of us men would cut a pretty poor figure under such a test.

I confess that this short cut to animal psychology through the laboratory interests me very little. Laboratory experiments can lead to little more than

negative results. They prove what the animal does not know and cannot do under artificial conditions, but do they show what it does know and can do under natural conditions?

I grant that you can prove in your laboratories that animals do not reason — that they have nothing like our mental processes. But the observer in the field and woods, if he exercise any reason of his own, knows this. We see that the caged bird or the caged beast does not reason, because no strength of bar or wall can convince it that it cannot escape. It cannot be convinced, because it has no faculties that are influenced by evidence. It continues to struggle and to dash itself against the bars, not until it is convinced, but until it is exhausted. Then, slowly, a new habit is formed — the cage habit, the habit of submission to bars or tethers. Its inherited habits give place to acquired habits. When we train an animal to do certain "stunts," we do not teach it or enlighten it, in any proper sense, but we compel it to form new habits. We work with the animal until it goes through its little trick in the same automatic manner in which its natural instincts were wont to work.

I do not care to know how a laboratory coon gets his food out of a box that is locked; but I should like to know why he always goes through the motion of washing his food before eating it, rubbing it in the

sand or sawdust or straw of his cage, if no water is handy. I should like to know why he is fond of shellfish, and how he secures them, since he is in no sense an aquatic animal. In the laboratory you may easily learn how a mink or a weasel kills a chicken or a rat; but how does it capture a rabbit by fair running in the woods or fields, since the rabbit is so much more fleet of foot? In the laboratory you might see a black snake capture a frog or a mouse; but how does it capture the wild bird or the red squirrel in the woods? It is this interplay of wild life, the relations of one animal with another, and how each species meets and solves its own life problems, that interest us, and afford us the real key to animal behavior. I fancy the keeper of the Zoo can really learn very little about his animals that is valuable and interesting. Or what does the public get out of its Sunday or holiday visits to a zoölogical park, besides a little idle amusement? The beasts there are all prisoners; and they are more dejected and abnormal than human prisoners would be under like conditions, because they are more completely cut off from their natural surroundings.

With very low forms of animal life the case is different. They are affected very little, if at all, by the presence of man and by artificial conditions. Professor Loeb's experiments with the medusæ, ascidians, worms, and mollusks established many things about these low forms well worth knowing, — and

that could have been learned in no other way — his demonstration, for instance, that certain phases of tropism, response to external stimuli, is the same in both animals and plants. His demonstrations that life can go on without the nervous system, that irritability and conductibility are qualities of protoplasm, and that nature invented and improved the nervous system to secure quicker and better communication between the parts of an organism; the discovery that only "certain species of animals possess associative memory, and have consciousness, and that it appears in them only after they have reached a certain stage in their ontogenetic development" — that any animal that can be trained, that can learn, possesses this memory: all these things, and many others that Loeb has found out by his laboratory experiments, throw much light on the springs of animal life. It is not an instinct that drives the moth into the flame; it is a tropism — heliotropism. It is not an instinct that makes a bedbug take refuge in a crack; it is another tropism — stereotropism, the necessity of bringing the body on every side in contact with solid bodies.

Professor Loeb has shown that neither experience nor volition plays any part in the behavior of bugs and worms; they are machines set going by outward conditions. The warmth of the spring brings about chemical changes in the bodies of caterpillars that set them moving about. Wingless plant-lice, he says,

can at any time be made to grow wings by simply lowering the temperature, or by letting the plant upon which they are feeding dry out. The egg-laying mechanism of the blow-fly is set going by certain volatile substances contained in its meat, and this he calls chemotropism.

Still, one would like to know how this particular kind of machinery came to be developed in the blow-fly. The terms "reflexes" and "tropisms" do not give a plummet-line long enough to sound all the depths of animal behavior. With them one may measure very well the conduct of the lower organisms, such as radiates, articulates, mollusks. The lives of these creatures are mainly a series of reflexes or tropisms. We could not correctly speak of the psychology of a clam, an oyster, or a worm, because they have no psychic life; but their tropisms or automatic responses to stimuli are interesting to study. These lower forms have no instincts, properly so called. Not until we get higher in the scale of life, and reach animals that have associative memory, do we reach the region of psychics, and find that complex behavior which we designate as instinctive, and which results as much from inborn impulses as from outward stimulation.

Loeb is of the opinion that all so-called instincts will ultimately be explained on purely physiological principles, that is, on the physical and chemical qualities of protoplasm. When this is done, the difference

between reflex and instinctive actions will disappear. The actions of both men and beasts will turn out to be reactions to external stimuli. Probably, everything in this world has its physics, has its genesis and explanation somehow in matter, from chemical affinity to human passion, from animal instincts to the poetic frenzy. That marvelous invention, the phonograph, has its physics as surely as the steam-engine has. But how inadequate the mechanical explanation of it seems. That the tone of a bell, the peal of a bugle, the wail of a violin, the ring of an anvil, and, above all, the soul of the singer, as revealed in the human voice, can all be evoked from these fine, wavy lines in the disk — how incredible!

The soul of man certainly has its physics; our thoughts, our emotions, all have their physical basis in protoplasm. I do not think that the brain secretes thought as the liver secretes bile, but I do believe our thoughts are as much the result of physiological conditions as bile is. An analysis of the brain and an account of all its chemical elements and properties would fail to reveal to us the secret of its thoughts, or why one brain has thoughts of one kind and another of another kind; yet, no doubt the cause is there, the actual, material, physiological cause, if our analysis were keen enough to find it. Our search would be as futile as our search for the complex music that slumbers in the records of the phonograph.

As a scientist one cannot admit anything mystical or transcendental in nature, while, on the other hand, the final explanation of the least fact is beyond us. We know certain things about chemical affinity, for instance; but what makes chemical affinity? Why are certain substances so crazy to be locked in each other's embrace? Why, that is chemical affinity. But what is chemical affinity? The instinct of migration in birds doubtless has a psychological basis; but whence this basis? How did it come about? The instinct of the male for the female doubtless has a physiological basis, but whence the basis? All instincts have their physics, but are they on that account less instinctive? After we have explained them, are they any the less untaught, any the less independent of experience? Some kinds of chemical and physiological stimuli make the heart beat, but does that clear up the mystery? Why is this muscle and no other so susceptible to these stimuli? Why is the heart the heart?

It takes time to develop and establish the instincts of the lower orders, as it takes time to develop the reason in man. Not until an animal's organization approaches maturity do all its reflexes act promptly and surely. It is not a question of experience or of acquired habits, but of physiological development. It takes nine days for the kitten's eyes to open, and it takes longer than that for the preying instincts to develop. The baby does not

wink, when you threaten its eyes with your hand, until it is two months old, but its sucking instinct seems to be developed when it comes into the world. Its instinct of fear comes much later, and the little girl's doll-baby instinct, if such it be, comes later still.

Just at this point I am reminded of a curious error that John Fiske fell into in his otherwise admirable paper on the helplessness of the human young as a factor in human evolution. "The bird known as the fly-catcher no sooner breaks the egg than it will snap at and catch a fly." Of course this is absurd. When the young fly-catcher first comes out of the shell it can neither see nor lift its head. Its fly-catching does not begin until it is fully fledged, and then it begins instinctively; it is prompted to this by its organization and its inherited habits. So with the other forms of animal life. The young bird has wings, therefore it does not have to be taught to fly; the woodpeckers have bills made for drilling; therefore the drilling does not depend upon experience; the woodcock has a beak for probing mud and an inborn appetite for soft worms, therefore it instinctively probes mud. Does the young skunk have to be taught how to defend itself, or the young porcupine, or the young rattler, or the wasp, or the honey-bee on its first flight?

Squirrels are nut-eaters; therefore they know nuts the moment they see or smell them. Some species

of monkeys are egg-suckers. A monkey of one of these species knows how to deal with the first egg it comes across; a monkey not of such species makes a mess of the first egg. These are examples of instinct, automatic reactions, inherited habits. Birds not of the fly-catching species will sometimes pursue and try to capture a small moth or other insect; but how awkward and futile their efforts when compared with the quick, sure swoop and snap of the born fly-catcher. A sparrow never could learn to take a fly as the phœbe does, or a woodpecker to take a fish as the kingfisher does. Each kind of bird is a born specialist in its own line.

The career of every species of animal is determined for it when it is born, and before. The beaver does not have to be taught to cut down trees and to build a dam, nor the muskrat to build its house, nor the woodchuck to dig its hole. They come into the world with the tools and the impulses to do these several things. "Habit," indeed! So is the ebb and flow of tide a habit; so is the singing of the wind in the tree-top a habit; so is sunrise and sunset a habit. But the habit is as old as time and as new as the day.

IX

THE ANIMAL AND THE PUZZLE-BOX

I

I MUST beg my reader's indulgence in returning to the subject of the last essay. As there pretty clearly indicated, I have little sympathy with the laboratory method of studying animal behavior. I cannot make myself believe that much real insight can be had into its hidden springs by such methods. Of course, being a field observer of wild life, and a lover of the open, I am out of sympathy with the laboratory method to begin with. I am out of sympathy with the cold, mechanical, and businesslike procedures that it involves. The results have too much the character of the forced, the artificial, the unnatural. The laboratory method applied to man often leads to valuable results, because man lives and moves and has his being amid artificial conditions. Animal intelligence in the laboratory is, for the most part, conspicuous by its absence. The poor creatures, confronted by the strange conditions and the new problems, do not know what they do know, any more than men usually do under like circumstances. They are drilled into forming new habits, — the puzzle-box habit, the

labyrinth habit, or some other habit, — and after many trials they come to do their little tricks in an entirely automatic way. They appear to show no understanding whatever of the whys and the wherefores of the things they do.

Professor Thorndike found that it took on an average seventy or eighty repetitions of a trick with his chicks and cats and monkeys, to stamp the process into their minds, before they could do it correctly. The monkey did not seem to learn his trick of opening the puzzle-box any more rapidly by the professor's repeatedly taking hold of his paw and drawing the bolt for him. He seemed incapable of forming any concept on the subject. The trained animals we see at the show go through their various parts precisely as if they were machines. They don't know what they are doing any more than a clock does when it strikes. The normal current of their activities, which activities do not spring from ideas, or any mental concepts, but from innate impulses, is turned in a new direction and is kept flowing there till a new channel is worn. Professor Thorndike found that when a chick had been drilled to escape from a box by a roundabout way, it would stick to the roundabout way after the direct and easy way had been opened to it; in this respect being less free than the natural forces or elements which, the instant a barrier is removed, resume the old easy course.

The gulf that separates the mind of man from the mind of the animals below him — if we can call mind that bundle of instincts, reflexes, tropisms, and sense-impressions — is so great that I often wonder if I am wrong in feeling that it is as misleading to discuss or describe so-called animal psychology in terms of human psychology as it would be to discuss, the physiological functions of a bee or an ant in terms of our own physiology. The bee breathes and yet it has no lungs; the oxygen of the air reaches its tissues, and yet it has no blood; it smells, and yet it has no olfactories; it sees, and yet its eye has no parts analogous to the retina, the crystalline lens, and the aqueous humor; it has form and structure, and yet it has no bones, and it is only by courtesy that the anterior ganglion to which run the nerves of the eye can be called a "brain"; and yet behold the wonderful intelligence of the bees and the ants! In like manner, we might say that the dog reasons, and yet he has no faculty of reason; he remembers, and yet he has no faculty of memory; he experiences shame and guilt, and yet he has no moral conscience; he is resourceful, and yet he has no free ideas. Just what he does have that stands him instead, I think the laboratory inquirer is as powerless to discover as is the outdoor observer.

Animals find their way home, they communicate with one another, they are able to act in unison, by some means to which we are strangers. In not reach-

ing our state of reason, some compensation has been made to them; such intelligence as guided the world of animal life down the long æons before the advent of man, is theirs. Their wisdom is very old; man's is very new. They learned how to live, how to solve their life-problems, ages ago. Man has inherited much, though not all, of their knowledge, and through his new gift of reason he has added vast stores of his own to which they are and must always remain strangers. Through his new faculty he can go to them, and in a measure understand them, but they cannot in the same sense come to him.

I would not imply that the gulf that separates man from the higher mammals is as great as the gulf that separates him from the world of the invertebrates, high as is the intelligence that some of these forms display; but it is vastly greater than that which separates the other vertebrate orders from one another. They are all members of one family in the great house of Nature, differing in traits and capacities and habits, yet all alike the beneficiaries of natural law. Man in comparison is like a visitant from another sphere; his relation to the animal world is that of a superior being. He takes the globe into his hands and changes its surface, he crosses and uses natural forces, he reverses Nature's processes. If the animals could conceive of a god, man would be that god. His might transcends theirs, not in degree only, but in kind. Their tools are parts of their own

bodies, but man's tools are the great forces of Nature, and with his puny body he turns rivers, and removes mountains, or changes the face of a continent. Their life-problems are how to live and propagate their kind; his are these, and, in addition, how to master the secrets of the universe, and turn them to his own good, physical and mental.

II

Probably one reason why the laboratory investigator finds so little of what we call intelligence in his subjects is that he takes them out of the animal sphere and puts them in the human sphere. The problems he sets before them are human problems and not animal problems — they imply a knowledge of mechanical and artificial conditions; this places the dog, the cat, the monkey, the coon, in situations entirely foreign to those in which Nature places them, and to which their lives have been shaped. Ideas from the human plane are introduced into the animal plane. The way the cat and the dog deal with these might be a test of their human intelligence, but not of their native intelligence. An animal out of its proper sphere is likely to prove very stupid, while in its sphere, confronted by its own life-needs, it may surprise us by its resourcefulness. We know this to be true of men; why not, in a lesser degree, of course, of animals?

One need only note the misdirected fury of a

robin dashing at a supposed rival — its own reflected image on the window-pane of a darkened room — to appreciate what witless machines the birds are under certain conditions; or watch the raccoon seriously engaged in the farce of washing its food in the sand or the straw on the bottom of its cage, to reach the same conclusion. Yet in the field of their normal free activity, away from conditions imposed by man, how clever these creatures are! The animals show little wit in dealing with human problems, but their own natural problems they are fitted, both by organization and by instinct, to solve. Birds in nesting will often avail themselves of human handiwork and shelter, as when they build in our barns, or on our porches, or in our chimneys; but in so doing they are solving their own problems, and not ours. I heard of a well-authenticated case of a pair of robins building their nest under the box on the running-gear of a farmer's wagon which stood under a shed, and with which the farmer was in the habit of making two trips to the village, two miles away, each week. The robins followed him on these trips, and the mother bird went forward with her incubation while the farmer did his errands, and the birds returned with him when he drove home. And, strange to say, the brood was duly hatched and reared. But in this case the bird's primary problem, that of nest-building, was her own; human agency came in only accidentally, furnishing the nest's support. The inci-

dent only shows what a hustler and true American the robin is, and that he could have gone West with the farmers on a prairie schooner, and reared a family, or several of them, on the way.

I know it is hard for us to grasp the idea of a qualitative difference in intelligence, yet we seem almost forced to admit such a difference. A plant shows intelligence in getting on in life, in its many devices for scattering its seed, in securing cross-fertilization, in adapting itself to its environment; yet how this differs from human intelligence! When the curving canes of the black raspberry bend down to the earth at a certain time and take root at the end, do they not act as wisely and apparently as voluntarily as do some animals? Yet this intelligence differs in kind from that of man. The same may be said of the intelligence that pervades all Nature. Man's intelligence has arisen out of this cosmic mind through a process of creative evolution, but it is of a different order, it does not go with Nature as does that of the lower orders, so much as it bends and guides, or thwarts, Nature. An animal on the animal plane is one thing, on the human plane it is quite another. It is reasonable to suppose that it will show more wit in solving its own life-problems than it will show in solving those which man, in the fever of his scientific curiosity, sets for it. What could the indoor investigator learn of the cunning of the crow or the fox, of the sagacity of the dog, of the art and

skill of the bird in building its nest, and caring for its young?

The laboratory investigator has animal behavior more in a nutshell, and for that very reason is cut off from all perspective, all total effects. He cannot reconstruct a complete dog or cat or monkey out of his laboratory analyses without aid from free observation outside. He could learn very little about a collie dog, or a setter dog, in his laboratory that would enable him to infer all the capacities of those creatures, any more than he could of a man. Indeed, he would fare better with a man, because he could probe his mentality, his power of thought, though not his power of action. The animal acts, it does not think; and to test its power of action is harder than to test a man's thinking capacity.

In leading their own unrestrained lives there often is, among both wild and domesticated animals, something, some resourcefulness in meeting a new condition, some change of habit, some adaptation of new means to an old end, or old means to a new end, that looks, at least, like a gleam of free intelligence, or an attribute of true mind: as when a chipmunk cuts a groove in the side of a hole he is digging, so as to get out a stone he has struck, and then fills up the groove; or when a monkey selects a straw from the floor of his cage to poke an insect out of a crack in the side; or when wolves combine to run down a deer or a hare by relays; or a pointer dog, of his own

accord, runs round a bevy of quail that will not sit, but keep moving off, and places them between himself and the sportsman; or when gulls carry shellfish high in the air and drop them on the rocks to break their shells; or when, in Africa, a bird called the honey-guide leads the hunter to stores of wild honey — a fact which Roosevelt verified. We have no ways in the laboratory, or out, to assay such incidents and discover how much, if any, of the gold of real thought they contain. They may contain none, but may be only phases of the animal's instinctive activities, yet they are phases which the laboratory investigator is powerless to bring out. If there are degrees in instinct, as in judgment, then in the cases just cited we have the higher degrees.

III

The laboratory naturalist is hampered by the narrowness of his field: he has but one string to his bow, he has to do with only one phase or motive of animal life — the desire for food; the mainspring of the behavior of all his subjects is their hunger. Spurred on by the sight or smell of food they attack the problems he sets before them. All the rest of their varied and picturesque activities in field and wood, their multiplex life-problems for which Nature has equipped them, both physically and mentally, their loves, their wars, their home-making and nest-building, their migrations, their herdings, their

flockings, their rivalries, eluding their enemies, hunting their prey, their social instincts, their co-operation, — in fact, all their relations with one another, and with their natural environment, — from all this the indoor investigator is cut off; only the stimulus of food or the fear of punishment remains for him to work upon. His animals act only under the incentive of appetite. The greater the hunger, the greater the wit. The experimenters at times starve their subjects till they become abnormally eager and active. The food question certainly enters very largely into an animal's life, and its resourcefulness in obtaining food may well serve as one measure of its intelligence. But it has other life-problems, several of them, which are just as important, and about which it is just as keen, but which the experimenter cannot bring to bear. His laboratory is too narrow a field for these activities, as is even the large zoölogical park. He cannot study the migratory instinct, the flocking or herding or hunting instinct, nor, with the wild creatures, the mating and breeding instinct. He can throw no light on an animal's life-habits. He can find out how it will act under given strange conditions, but not how it behaves under its natural conditions. Hence the little interest the natural-historians feel in his inferences and conclusions.

It is true that the laboratory student of animal psychology can reach his results more rapidly than

can the field naturalist; he takes a short cut, he gets the bare fact, shorn of its picturesque details. But how much he misses! I sometimes think of him under the parable of a man dining on capsules that contain the chemical equivalents of the food we eat — a short cut, surely, but the pleasure and satisfaction of the dinner-table, social and gustatory, the taste of fruit and milk and meat and grain, are not his. Live natural history in the field and woods and on the shore, the uncontrolled animal going its free, picturesque ways, solving its life-problems as they come to it in the revolving seasons, using such mind as it has, without constraint or arbitrary direction, threading only the labyrinth which Nature prepares for it, stimulated only by the sights and sounds and odors of its natural habitat, perplexed with no puzzles but how to get its food, avoid its enemies, rear its young, hide its nest or den, and get out of life what there is in it — how much more engaging and stimulating an animal under such conditions than the same creature being put through its paces under controlled conditions in the laboratory.

So far as an exact science of animal conduct is possible, the experimentalist has the advantage over the free observer; so far as natural history is a joy, and of educational value, and an introduction to the whole field of animal life, he is not to be named the same day with the outdoor observer. Welcome, thrice welcome, all the light the laboratory method

of inquiry can throw upon the puzzle of animal mentality and its relation to our own; it is engaging the attention of some serious-minded men, and I would not undervalue its contributions to our knowledge of the springs of animal psychology. At the same time I am bound to say that I think it can take us but a little way into the great field of animal life. The true perspective of such life can only be given by the student of the uncontrolled behavior of our dumb friends.

The low valuation I set upon animal experimentation does not, as some of my readers seem to think, apply with the same force to all experimental science. Experimental science has given us our material civilization; what has animal experimentation given us? The inorganic elements and forces behave the same in the laboratory and out. But a live animal does not. You cannot control life as you can chemical reactions. Sound, heat, light, electricity, are the same everywhere, but an animal has nerves and instincts and associative memory. The dog with the puzzle-box is quite a different creature from the dog with the woodchuck.

Anything like an exact science of animal behavior is, it seems to me, as impossible in the laboratory as out of it. If animals were perfect automata, then we might have the science of animal behavior that the experimentalists dream of; but the conduct of

the same animals under identical conditions is dissimilar, or contradictory, as is that of different men. There is no rigid uniformity in their behavior. "A loud sound," says Professor Thorndike, "may make one chick run, another crouch, another give the danger-call, and another do nothing whatever." It is doubtless owing to such facts as these that experimenters arrive at such different results, often contradictory results. And we are not on any more permanent ground, according to Professor James, in the case of man himself: "A string of raw facts; a little of gossip and wrangle about opinions; a little classification and generalization on a mere descriptive level; a strong prejudice that we have states of mind, and that our brains condition them; but not a single law, in the sense physics shows us laws, not a single proposition from which consequences can causally be deduced."

G. Archibald Reid, speaking of the laboratory method of inquiry in biology, says, in his book on "The Laws of Heredity": "There is nothing especially magical, scientific, or accurate in data obscured to our senses till revealed by a laboratory inquiry. Such an inquiry can do no more than render them as patent, but no more patent, than the majority of facts on which our knowledge of living beings is based. . . . If the reader will think over the evidence on which I shall draw for the purpose of the present volume, I believe he will conclude that,

if any of it bears a doubtful aspect to his mind, it is that large mass which has been furnished by laboratory inquiry; for, while some of the latter is controverted, and all of it must be accepted by most people at second-hand, nearly all the rest is indisputably true, as he will know from his own experience of life."

IV

The university psychologist has little confidence in the ability of the field naturalist to interpret correctly "what he supposes himself to have seen," even if it be only the doings of a downy woodpecker excavating his chamber in an old post. What, he asks in substance, does one know about a downy woodpecker, which one has observed from one's front porch, excavating a cavity for a winter home in the top of a chestnut post? What does he know in detail of the bird's past experience, what of its age, what of its various sense-powers, such as its seeing, smelling, and hearing powers, what of the way its various powers have been developed, what of the number of times it has tried the same act and failed, what of the circumstances that may have enabled it to invent a new plan of action, whether it is an average bird of the species, or an unusual one, etc.? What indeed and how better off in this respect would the experimentalist be? The naturalist is probably familiar with the life and habits of the

bird, he may have seen it excavating its winter chamber many times, — not this same individual bird, but its duplicate in other specimens, — and he knows that each one of these shows exactly the same characteristics, though it is undoubtedly true that under pressure, in confinement, and in unnatural conditions, different birds would show different traits and aptitudes. Yet neither the naturalist nor the experimentalist could get at all the facts in the woodpecker's past life — its age, its failures, its stupidities, its rate of development, its sense-powers, and the like.

The experimentalist referred to would seem to imply that if he had the bird in his laboratory he could settle all these points; whereas it seems to me that the field observer knows just as much about these things as the laboratory experimenter could know. Neither can get at all the exact facts in the bird's past history, while it is extremely doubtful if, in confinement, the bird would even attempt to excavate a chamber in a post, or exhibit any of its natural aptitudes, or give any clues to its real life-history. The acuteness of its various senses can surely be better tested in the open air than in the laboratory, because in the open it is leading a free, natural life, while in the cage it is leading a constrained, unnatural life. It might be trained to run the maze, or to pull a string to open a puzzle-box; but of its real life what would or could the bird

disclose to you in rigidly controlled experiments? If the free bird is endowed with any sense-powers of which the "mere observer" can gain no first-hand knowledge, what chance has the laboratory observer of gaining a first-hand knowledge of them?

The field observer sees the woodpecker excavating a cavity in a dry limb or stub in the autumn; he sees that all birds of this species proceed in exactly the same way, because they all have the same organization, and hence the same needs; he sees how carefully the bird usually places its entrance where it will be more or less shielded from driving storms; he sees that it rarely or never selects a limb that is too rotten, or insecure; he sees where it makes many beginnings and then abandons the limb because, apparently, it is too soft or too hard; he sees the bird cautiously resorting to these retreats as night comes on; he sees him living alone in there, little hermit that he is; he sees how he is often dispossessed of his cabin by the hairy woodpecker, or by the flying squirrel, or the English sparrow; he sees him selecting a dry resonant limb for a drum in the spring, on which to drum up a mate; he sees his changed demeanor when the female appears, the curious, mincing flight, as if on the tiptoe of his wings, with which he follows her about — he sees, in short, a long series of interesting facts which reveal the real psychology of the bird, and

of which the laboratory naturalist could get no inkling.

The laboratory study of the animal mind is within its proper limits worthy of all respect, but you can no more get at a complete animal psychology by this method than you can get at the beauty and character and natural history of a tree by studying a cross section of its trunk or of one of its branches. You may get at the anatomy and cell-structure of the tree by this means, but will not the real tree escape you? A little may be learned of the science of animal behavior in the laboratory, but the main, the illuminating things can be learned only from observation of the free animal.

I fear that the experimenters unduly exalt their office. The open-air naturalist arrives at most of their results, and by a much more enjoyable and picturesque route. Without all their pother and appliances and tiresome calculations, he arrives at a clear conception of the springs of animal behavior. The indoor investigator usually experiments with domestic animals, animals that have been much changed and humanized by ages of association with man, such as the cat and the dog. What important addition has he made, or can he make, to our knowledge of these animals? He has learned that the dog is probably color-blind, which one might have easily inferred, since the color-sense could be of little use to the dog, or to any other quadruped. A power

to discriminate different degrees of brightness might possibly be of use, and this the animals may have. This is the gift of the color-blind man, and is of course a much older gift than the color-sense. But of the dog's marvelous powers of scent, as displayed by the setter and the fox-hound, he can learn little. Of his real intelligence and of his various capacities and capabilities, he can learn little. We do not need laboratory experiments to prove to us that the dog's touchstone is his nose, and not his eye; his eye is of second- or third-rate importance to him; his ear serves him more than his eye; he does not know his own master till he has got his scent or heard his voice. For the most part he sees only objects in motion. A fox will pass to windward within a few feet of the hunter if the hunter is silent and motionless. There is little power of discrimination in the eye of any of the canine tribe; the acuteness of their other senses makes up for it. The eye of a bird — a crow, a hawk — how different! Sit as motionless as a statue, and you cannot escape the eye of the crow — though the eyes of all animals are especially sensitive to objects in motion. Probably none of them can discriminate a motionless object as a man can. They have not reason to aid them. A man's seeing is backed up by his stores of knowledge. The way certain animals can be "flagged" shows how superficial their seeing is. The way a hawk will allow the approach of a man on

horseback shows how little speculation there is in his eye.

The thorough student of animal life knows that animals do not reason or have any mental concepts, that one can train them to form habits, but cannot develop their intelligence; that is, that they can be trained, but cannot be educated. He knows they have no self-consciousness, from such a field observation as this: song-birds with a defective instrument will sing as constantly and joyously, even ecstatically, as the perfect-voiced songsters. A bobolink with only a half-articulated song will hover above the meadows and pour out his broken and asthmatic notes as joyously and persistently as any of his rivals; apparently he is as oblivious to the inadequacy of his performance as a machine would be. Last spring one of our roosters got a bad influenza, or in some way injured his vocal cords, so that only half of his crow was audible, and this half was very husky and unnatural; yet he went through with the motions of crowing just as persistently and triumphantly as ever he had. He gave his rival crow for crow day after day. It was a grotesque performance and was to me proof of how absolutely void of self-consciousness the lower animals are.

One is convinced on general principles that an animal knows only what it has to know in order to survive; that when keenness of scent or of hearing or of sight is not needed, it does not have it; that

animals that are defenseless, like the rabbit, have speed and are prolific; that animals that are self-armed, like the tortoise and the porcupine and the skunk, are slow and dull of wit. One does not need elaborate experiments to prove that the pigeon would be slower in learning to run the maze than a squirrel or a rat; he knows that all animals are more or less imitative, that the young imitate the old, and the old imitate one another; that monkeys by their behavior alone are nearer man than the dog or the cat.

The work of the experimentalist may supplement that of the field observer, but it cannot take its place. "Experiment has an advantage over observation," says a German writer on logic, "only so far as it is capable of supplementing the usual deficiencies of the latter."

We cannot make Darwins in the laboratory, though the laboratory may give Darwin a fact or a hint now and then that will be of service to him.

V

If our experimenters can now prove that birds are color-blind they will raise havoc with Darwin's sexual selection theory. Let them experiment upon the peacock, the Argus pheasant, and other birds of brilliant plumage. The males of many of our small birds are brilliantly colored; what part does this play in their lives? If orange, crimson, yellow, blue, and the various metallic lustres and changing irises are

not discriminated by these birds, or do not give them pleasurable or exciting sensations, then we have to look for some reason for their gay plumes other than the approbation of the female. Our experimental psychologists have tested the powers of the painted turtle to discriminate white and black. But one fails to feel much interest in the result of such experimentations, be they what they may, because the facts can have little or no relation to the creature's life-problem. But the turtle's gay colors — can it discriminate those, and what part do they play in its life-history?

On the Darwinian hypothesis of sexual selection, the gay colors of the painted turtle have a deep significance, as do the brilliant colors of all other animals. Does the turtle or his mate discriminate these colors? is he attracted by them? do they play any part at all in the turtle's real life? Our common box tortoise has striking and beautiful color-patterns on its shell, often suggesting Chinese characters. Can the laboratory naturalist find out their significance, or that of the brilliant markings of many of the lizards and salamanders; do these animals see and know their own decorations? Or the many brilliant beetles and butterflies — are they color-blind also? A. G. Mayer has proved conclusively that the promethea moth has no color-sense. The male of this moth has blackish wings and the female reddish-brown. Mayer caused the two sexes

to change colors; he glued the wings of the male to the female and *vice versa*, and found that they mated just the same. The laboratory experimentalists ought to be able to throw light upon these questions.

Elaborate experiments have already been made to test the color-sense of certain birds, — the English sparrow, the cowbird, the pigeon, — and also such animals as the raccoon and the monkey, with the result that these animals do appear to discriminate colors. But there always remains the question: Are the animals guided in such cases by a sense of color as we have it, or merely by a sense of different degrees of brightness? A person who is color-blind sees the different colors as varying shades of gray, and for aught we know it is the same with the animals: in selecting, say, blue or green, they may only be selecting different shades of gray.

I should like also to see our experimentalists test the musical sense of birds: are they tone-deaf in the sense that they are probably color-blind? Is the divinely harmonious strain of the hermit thrush, for instance, lost upon the ears of its mate and upon its own ears? Does the rollicking and hilarious strain of the bobolink count for nothing in its life? From the apparent indifference of the female song-birds to the musical performances of their mates, one would say that the strains of the males fall upon deaf ears. When the cock in the poultry-yard crows, the hens shake their heads as if the sound annoyed them. The

lark pouring out his notes up in the sky seems singing from the joy of song alone. The song of a bird excites the males of its species to rivalry, but the females are as inattentive as if they had no ears. I am myself inclined to think that the songs of birds are a part of the surplusage of the male sexual principle, like their bright colors, and that to their mates they are merely noises. The males sing in the absence of the females just as joyously as in their presence, as note the caged canaries; and the harsh, raucous-voiced birds are as acceptable to their mates as are the musical-voiced to theirs. Why should it not be so? A consciousness of the pleasure of melodious sounds would seem to lift the bird out of the animal plane into the human plane.

I wish our laboratory investigators would tell me, if they can, what sense or faculty it is that enables one bird to pursue another so unerringly — a hawk in pursuit of a sparrow, or a song-bird pursuing another in sport, the pursuer trimming its movement to those of the pursued as if the two were one body. When a dog pursues a squirrel or a rabbit, if the pursued darts suddenly to one side it gains time, the hunter overshoots, and has to recover itself; not so with the birds, there is no overshooting, no lost time, and no recovery. It is as if the pursuer could read the intentions of the pursued at every movement, and anticipate every dodge and turn. It is probably some analogous gift or sense that enables a flock of

birds to act as a unit, without leaders or signals, and perform their astonishing aerial evolutions as if the flock were one bird, and not a hundred. All the truly gregarious birds will do this. Does the flocking instinct beget a sort of community of mind, so that the individual members share each other's psychic or mental states to an extent quite unknown to us? This opens up the whole question of animal communication.

In the absence of language and reason, how do the animals over a wide extent of country become possessed of the same knowledge and the same impulse at the same time, and begin their movements simultaneously? The vast moving armies of the passenger pigeons in the old days, the migrating crowds of the lemmings in Norway, of reindeer in Siberia, and of caribou in Labrador, every spring — how do these all act in such concert? Hunted animals suddenly become wild, — even those which have had no individual experience with the hunter, — as if the tribe were a unit, and what one knew they all knew at the same time. One would like such problems cleared up. I have no doubt at all that the higher animals have some means of communication which the race of man, since it came into the gift of language and of reason, has lost, or nearly lost, and that our fitful and exceptional experience of becoming aware of what our friend or companion is thinking about, that experience which we call telepathy, is a

survival of the lost power. There is something like a community of mind or of emotional states among the lower orders, to which we are strangers, except when, under extraordinary conditions, — as in the frenzy of mobs and like unreasoning bodies, — we relapse into a state of savage nature, and behave as the wild creatures do. In such cases there is really a community of mind and purpose. But birds in a flock possess this oneness of mental states as a normal and everyday condition. Fish and insects in vast numbers often show a like unity of instantaneous action.

There is so much in animal behavior that is interesting, and that throws light on our own psychology and its origin, that one begrudges the time spent in learning that dancing mice are deaf, or the numerous data as to the tactual sensations of the white rat, or "the relative strength of stimulus to rate of learning in the chick," or the psychic reactions of the crayfish, or cockroach, or angleworm, or grasshopper, unless they yield the key to some large problem. We do not want elaborate experiments to prove that frogs can hear — does not every schoolboy know that they can, and see, too? Though he may not know that "there is some evidence that the influence of auditory stimuli is most marked when the drum is half-submerged in water," or that "the influence upon tactual reactions is evident when the frog is submerged in water to a depth of four centi-

meters," or that "sounds varying in pitch from those of fifty to ten thousand vibrations a second affect the frog." But what of it? Who is really the wiser for this discovery? I know there is no reason why I should quarrel with men who prefer to dine on the concentrated equivalents of our meats and viands. Rather should I wish them a good appetite for their capsules. At the same time I can see no good reason why I should not extol the pleasure and the profit of taking our natural-history manna of field and wood as Nature provides it for us, and with a relish that only the open air can give.

X

UNTAUGHT WISDOM

THOSE who have read some of the things I have published in which I have discredited the reasoning power of the lower animals write me stories of the wonderful intelligence of their cat or their dog or their horse or their canary, and seem to fancy I am or should be silenced. Now I admit that the dog often does things that seem to transcend instinct, but I admit it reluctantly, and ease the admission by the word "seems." I am not certain but that instinct, modified and trained by hundreds of thousands of years of close companionship with man, is adequate to account for all he does. I am not certain that after all these ages of human association his mind is developed beyond that of his brother the wolf. He is gentler, more confiding, and more adaptive, but his cunning and his prowess are less, and I doubt if he is any more of a rational being. Domestication improves the wild animals, not by developing their intelligence, but by subduing their wildness and making them more submissive to our wills. Like the wild grains and fruits, the more able they are to serve us, the less able are they to shift for themselves. Those persons who

look upon instinct as an inflexible, cast-iron rule make a mistake. No live thing is entirely a machine; the vital forces certainly act in ways quite different from the mechanical; and yet I am convinced that the behavior of the lower orders is, for the most part, automatic.

The manlike apes undoubtedly show gleams of what may fairly be called reason; and trained elephants develop a wit that at least gives us pause. One has to be careful how he ascribes reason even to the highest of the lower animals, because there are creatures which we look upon as much lower in the scale of life that yet exhibit a degree of intelligence apparently on a par with reason.

For instance, take the case of the little hermit crab. This creature has no shell of its own, so it takes for its habitation the shell of some other sea-animal, often that of the whelk. Upon this shell the sea-anemone often grows, and reaps its advantage in being moved about from place to place by the crab. And the crab finds its advantage in the copartnership, or what the biologists call the "symbiotic association," in the tentacles of the anemone which come down near the head of the crab and seem to afford it some measure of protection. If from any cause the anemone be torn away from the shell, what happens? Now here is where the great reasoning powers of the hermit come in; it hunts about seeking another anemone, and when it finds it growing upon

some object, it struggles to loosen it, and, having done so, places it on its shell. It wants the protection the anemone affords it. At least that is what the biologists say. Now whose cat or dog or horse does anything half as wonderful as that? And yet shall we believe that this all but brainless crab possesses the faculty of reason?

Many incidents might be cited from insect life that are quite as wonderful. The ants and termites do things that seem to imply an unmistakable faculty of reason, at the same time that they do things or allow things that seem almost idiotic, as when a large species of ant allows the little thief ant to live in its nests and devour its eggs or larvæ and never seems to know what is going on. But take the case of the ichneumon-fly, which lays its eggs on or near some caterpillar or beetle grub. When the eggs hatch, the young ichneumon burrows into the body of its host, feeding on its tissues, but not attacking such organs as the heart or the nervous ganglia. Why not? Because injury to these organs "might mean immediate death to the host," and consequently death to the young ichneumon. Shall we say, then, that this hungry "milk-nosed maggot" reasons? Something reasons, or has reasoned in this case, but is it the maggot?

The same kind of reasoning power appears to be possessed by some trees and plants. Behold the candelabra tree in South America as described

by Weismann, which protects itself from its great enemy, the leaf-cutting ant, by harboring inside its hollow branches another species of ant, which makes war upon the leaf-cutters. To requite these ants for the protection they afford the tree, and to attract them to it, the tree has developed a special kind of food for the ants at the base of the leaf petioles, just where the danger is greatest. There are said to be other species of this tree that do not develop this food, and they do not have the ants to protect them. The story is almost incredible, because it seems to make a thinking, planning, reasoning being of a tree, but the fact I have stated seems well established. What shall we say, then? Do these low forms of life possess man's faculty of reason, even if they behave in this very reasonable way? I do not believe it, any more than I believe the ingenious mechanical device of the orchid to secure cross-fertilization is the result of reason in the orchid. We must call it by some other name. Its genesis is different. Human reason progresses, invents, finds new ways. It is like man's two hands, which can be turned to many uses. Man's organization and physical powers are not specialized as the lower animals' are; he is free, and master of many fields; his superiority is mental, not structural like that of the bird. The specialization is in his mental powers, the power of reason, which gives him dominion as the wing gives dominion to the bird.

How animal knowledge differs from human knowledge is well illustrated by one of the solitary wasps that Sir John Lubbock tells about. When this wasp lays an egg, she knows whether the egg will produce a male or a female; the female grub needs more food than the male, and the wasp always puts five insects by one, and ten by the other. And yet are we to believe that she counts in the human way? I cannot believe that she does. I cannot believe that she has any knowledge, in the human sense, about the sex of her eggs. She does this thing as automatically and unfailingly as a machine. Remove any of her insects, and she does not miss them.

How the lower forms of life — ants, bees, bugs — know what they seem to know is a mystery. They know without having to learn as we do. They know from the egg. If any of them had the gift of reason, they would have to learn in the human way, they would have to travel the painful road of experience, and suffer defeat many times. But they know not defeat, they know not failure, they know neither the perplexities nor the triumphs of reason, any more than the elements do. Their wisdom comes into the world with them, and is much older than they are.

How the sacred beetle knows that the grub which hatches from its egg in the chamber underground, will need air, and plans her cradle accordingly; how the wasps and solitary bees happen to be such expert anatomists that they know the

precise spot in which to sting the spiders and locusts which they gather for their young, so that the poison will paralyze but not kill the victim, — how they know that the rose-beetle needs to be stung in one point only, but that the cricket has three nerve-centres that must be paralyzed, and that a certain caterpillar requires nine strokes upon nine nerve-centres, — how these and scores of other curious facts come to be known to insects, is past finding out. I suppose we might as well ask how the organs of our own bodies know so well how to perform their special functions, or how the plants and trees know the best way to scatter their seeds or how to adapt themselves to their environment.

It would seem as if all nature were pervaded with mind or mind-stuff. As science has to assume the existence of the all-pervasive ether to account for many physical phenomena, so, it appears to me, we have to postulate this universal mind to account for what we find all around us. Things are so wise! The lowest organisms know from the start all that it concerns them to know. I say "know," when of course, in the strict sense, there is no knowledge involved in their behavior; it is only a question of an inborn impulse. But whence the impulse? We only rest with words when we say it is the nature of organisms to do so and so. What gave the particular bent of impulse to this nature?

A wild plant that gets a late start, or that grows in a cold climate, will make less length of stalk than the same plant when it gets an early start, or when it grows in a warmer climate, reserving its energies to produce and ripen its seeds. If it can be shown that all this is the result of mechanical or chemical laws, I still want to know why these laws act thus and not otherwise; I want to trace to its source this solicitude about the seed.

Is not man's wisdom also older than himself? Is not every pound of force that he uses through his own members, or through the mechanisms that he invents, a part of the sum total of the force of the physical universe? In like manner, may we not infer that every spark of intelligence he shows, or is capable of showing, is a part of, or a manifestation of, the intelligence that pervades all things? As he modifies and uses the cosmic force through his various mechanical devices, so the cosmic intelligence is modified and individualized through his reason and personality. The inorganic intelligence of universal nature, so to speak, becomes organic intelligence in the realm of life, appearing in the lower orders in what we call instinct, and in man as self-knowledge and the higher consciousness.

Our cats and our dogs are, as it were, pulled along in our wake. They learn without instruction to do certain things which they see us do, if these things are in a line with their natural activities, such as

clawing, pawing, jumping, and seizing. They learn to open gates and doors and pull cords, and many other things. I recently saw a common cur dog that would sing when told to do so; he would lift up his head, and send forth a long, low, rather musical howl. This came easy to him, as howling is one of the dog's natural accomplishments. A dog loves to play at the game of hunting the ball or the stone which you throw, because this act is in a line with his instincts, and he never tires of the fun. Of course a dog can be trained to do almost anything, but to enlighten his mind about the whys and the wherefores of the thing is quite another matter. You can train an animal to act, but can you train it to think? Of course your dog or your horse could not be trained to do its trick did it not possess certain powers that may be called mental, such as power of attention, power of imitation, power of association, and capacity to feel a stronger will. But these powers are all phases of the animal's instinctive activities, and do not presuppose judgment or reason. When we train an animal, we make, as it were, an artificial channel for its mental currents to flow in, and they flow there without conscious choice or self-direction, as water flows in the channel we make for it. How helpless they feel themselves to be, poor things! If the lions knew their own strength, how they could defy their trainers! But they have no self-knowledge or self-thought.

A recent nature writer says he can understand an animal only by putting himself for the moment in the animal's place. Will he not in that case make the animal think and reason as *he* does? Let him put himself in the animal's place and remember what he does from habit, his unconscious automatic acts, and then he will get some insight into animal psychology. When we do a thing from pure habit and unconsciously, we act as the animals do, without thought or reason, we know not what we do; like a child when it sucks, or a bird when it sings.

As we go our round of duties from day to day, we do many little things without thinking about them at all. We shut the door behind us, we wind our watches, we put out the light, or similar slight acts; we do things "absent-mindedly," as we say, and we do them correctly. We know what wonderful feats sleep-walkers sometimes perform, and frogs will do certain acts intelligently with most of their brains removed. The animal's life is evidently a kind of sleep-walking, or absent-mindedness, that is, when compared with our conscious self-direction. We are awake and know that we know, but the dog or the horse is not aware of his own knowledge.

I do not think the position is tenable which Jordan and Kellogg take in their work entitled "Evolution and Animal Life," namely, that it is a power of choice that distinguishes reason from instinct. A hunted animal may take this course or that without any act

of reflection or reasoning as to which may prove the more advantageous. You may see a robin exploring a tree, looking for a place to build her nest; she chooses this limb or that; does she therefore reason about the matter? In building it she takes one straw and rejects another; is she therefore arguing with herself all the time? One place and one weed stalk pleases her, and the other does not. That, I fancy, is all there is to it. Offer a baby two different-colored balls, and it will choose between them. Is this choice an act of reason?

These authors tell an interesting incident of two monkeys, one of which was of an egg-eating species and the other of a nut-eating species. He of the egg-eating race took the first egg he had ever seen and proceeded to crack it and suck out its contents, after the manner of his tribe. The other one cracked his egg as if it were a nut, and the inside ran out and fell upon the ground. After looking at it for a moment in a bewildered way, he scooped it up, sand and all, with his hands and swallowed it, and then ate the shell also. Then the writer makes the astonishing statement that this was an act of reason on the part of that monkey! Instinct failed him, and reason came to his aid and prompted him to devour the egg! Is it not much easier to fancy that an instinct came to his aid that was much older than his special nut-eating instinct — the simple eating instinct itself? The egg proved to be a kind of food that ap-

pealed to him, and he swallowed it. It was no more an act of reason than was that of the other monkey. If I myself were offered a new viand or a new fruit, my eating of it would not be an act of reason, but the prompting of taste and appetite. I once saw my dog eat a beefsteak mushroom, but I am sure it was not his reason that prompted him to do so, but the good smell of the mushroom. A coon knows how to suck an egg because he comes of a race of egg-suckers, but the tame coon I had in my youth knew instantly what to do with the first pancake it ever saw. When we know not what we do, when we act from an impulse or without thinking, then we act as do the animals. When we stop to consider, or act from thought or judgment, then we are rational beings.

XI

THE BOW IN THE CLOUDS

WHOSE heart does not leap up, be he child or man, when he beholds a rainbow in the sky? It is the most spectacular as it is the most beautiful thing in the familiar daily nature about us. It has all the qualities that are most calculated to surprise and delight us — suddenness, brilliancy, delicacy, sharp contrasts, and the primal cosmic form, the circle. No eye so dull but turns to it with pleasure — a painted triumphal arch, yet as intangible as a dream, suddenly springing athwart the dark storm cloud. Born of the familiar and universal elements, the sun and the rain, it is yet as elusive and spectral and surprising as if it were a revelation from some other sphere. It is a kind of incarnation of the spirit of beauty — a veritable wraith that hovers and retreats before you like an angelic visitant. It is fixed there against the cloud, irrespective of the falling motion of the drops of rain through which it is formed. They fall, but it does not fall. They are swayed or whirled by the wind, but the bow keeps its place. That band of prismatic colors is in no sense a part of the rain, and the rain knows it not. It springs out in the rear of the retreating

storm, but the storm knows it not. The eye knows it not, and sees it not unless placed at a certain definite point in relation to it. The point of view makes the bow. No two persons see precisely the same rainbow; there are as many bows as there are beholders.

Sometimes we see two rainbows, as if nature were in an extra happy mood. In the second one the colors are in reverse order from that of the first. The first is due to the rays of the sun falling upon the outer portions of the drops and suffering two refractions and one reflection before reaching the eye, while the second bow is due to the rays falling on the inner side of the drops and suffering two refractions and two reflections.

The rainbow is an apparition of color and form in the air. It is not so much an entity as the radiant shadow of an entity — fugitive, unreal, phantasmal, unapproachable, yet as constant as the sun and rain.

The sunset is afar off, painted upon the distant clouds, but the rainbow comes down to earth and spans the next field or valley. It hovers about the playing fountain; it beams out from the swaying spray of the cataract. It is as familiar as the day, yet as elusive as a spirit, — a bow of promise, indeed, — a symbol of the peace, the moderation, and the beneficence in nature that brought man upon the earth and now sustains him here.

What æons must have passed in the history of the earth before the elements reached that har-

mony and equipoise which the rainbow indicates! — the sunshine following the shower, the clearing up of the weather, the obscurity and the turmoil succeeded by a cleansed and illuminated air. What æons of warring elements before the first bit of blue sky appeared! Countless ages of mist and floods and darkness and sulphurous clouds — a rising-up of the deep and a falling-down of the heavens — before the earth saw the first smile of clear sky and the first bow of promise set in the clouds. Not till the cooling rains began to fall could life appear upon the land; not till the sun had penetrated the mists and gases that must have enveloped the earth for millions of years, could the rainbow be set on high.

It is a pleasing fancy, and it may be a scientific fact, that there were no flowering plants till the rainbow appeared. Of course the laws of optics have always been the same, but the conditions determining their operation as we see them are recent, geologically speaking. The many-colored flowering plants did not appear till long after the overburdened and superheated air had been cleared of its vapor and carbon dioxide by the rank vegetable growths that gave us our coal beds, that is, till long after Carboniferous times — probably late in Mesozoic times. With clear skies and sunshine the development of bright flower-petals would take place, and with these conditions the bow would appear in the clouds. Maybe the rose and the rainbow were born

on the selfsame day. At any rate, behold the bow like a flag flung out in a festive and holiday spirit, that cheers and stimulates all beholders! Festivals and holidays are exceptional in our lives, and there may be nothing strictly analogous to them in the operation of the elemental forces, but this triumphal arch so suddenly sprung across the dark abyss of the storm-clouds certainly affects the beholder as a sign of gayety and peace and good will in nature. The sunshine itself might indicate this, but the bow emphasizes it and heralds it as with banners.

The rainbow is of the earth, it is dependent upon the familiar rain, it hangs over the near field or grove, and yet it is from out the heavens; it brings the cosmic circle, the perfect curve of the sun and moon, and paints it upon the shifting mist of the storm. Not often in the organic world does nature repeat the precision of her astronomic curves and circles; in the wavelet which a dropped pebble sets going in a pool of water, in the human eye and in the eyes of some of the lower animals, and in some vegetable forms does she draw the perfect curve. Astronomy comes down to earth now and then and casts its halo about familiar things.

The rainbow shall stand to me for the heaven-born in nature and in life — the unexpected beauty and perfection that is linked with the eternal cosmic laws. Nature is not all solids and fluids and gases, she is not all of this earth; she is of the heavens as well.

She is of the remote and the phenomenal; seen through man's eyes she is touched by a light that never was on sea or land. Neither is life all of the material, the tangible, the demonstrable; the witchery of the ideal, the spiritual, at times hangs the bow of promise against the darkest hours.

I do not mean to be fantastic, or to give the fact more sail than it can carry, yet I cannot but feel that the rainbow has a deep significance, and in its flitting, intangible, transmundane, yet beautiful and constant character, may well be a symbol of much that there is in nature and in life.

XII

THE ROUND WORLD

I HAVE a neighbor, a man now over eighty years of age, who has a philosophy of his own about most things, and who does not believe that the earth is round, nor that it turns round; and he can prove it to you, to his own satisfaction, with his level on the floor. I confess I sympathize with him, and half hoped he could prove it to me, as I am turned topsy-turvy every time I try to see myself on a round globe; but I am also bound to confess that he did not quite convince me.

I fancy that all persons who think much about the matter have trouble to adjust their notion of a round world to their actual experience. After we have sailed round the world and seen its round shadow eclipsing the moon, and seen the ships drop below the horizon at sea, we still fail to see ourselves (at least I do) as living on the surface of a sphere; by no force of imagination can I do so. The eye reports only a boundless plain, diversified by hills and mountains; and travel we never so far, we cannot find the under side of the sphere—we can never see ourselves as we see the house-fly crawling over the side of the globe in our room, and we wonder why we do not

drop off or see the sky beneath us. Yet when we reach the South Pole, the sky is still overhead, just as at the North. This is the contradiction that staggers our senses.

The truth is that as dwellers upon the earth, we are completely under the law of the sphere, so completely that we cannot get away from it even in imagination, without seeing ourselves involved in a world of hopeless contradictions. The law of the sphere is that there is no up and no down, no over and no under, no rising and no falling, apart from itself. Away from the earth, in empty sidereal space, we should be absolutely lost, and should not know whether we were right-side-up or not, standing on our heads or our heels, because we must experience a negation of all direction as we know it here. We might know our right hand from our left hand, but can we picture to ourselves whether we should be falling up or falling down, whether the stars should be over us or under us?

Or go to the other extreme, and fancy yourself at the centre of the earth; which way would your feet point, up or down? Which way would things fall? Try to imagine the dilemma you would be in, if you could tunnel through the earth, when you came out on the other side! And what is curious about it all is that our experience with balls and spheres, little and big, does not prepare us for these contradictions. Every globe we see, even the sun and moon,

has an upper and an under side. If we fancy ourselves on the moon we see the heavens above us at the North Pole, and below us at the South. Is not the fly crawling over the under side of the globe in our room in a reversed position? Yet we know from actual experience that, go where we will on the earth's surface, we are right-side-up. We find no under side. The heavens are everywhere above us, and the ground is beneath us, and falling off the sphere seems and is impossible. We nowhere find ourselves in the position the Man in the Moon would appear to be in if we could see him searching for the South Pole. South Pole and North Pole are both the same so far as our relation to them is concerned.

The size of the globe, be it little or big, cannot alter the law of the globe. If we were to make a globe ten miles or a hundred or a thousand miles in diameter, it would still have a top and a bottom side, and if we placed the figure of a man at the South Pole his head would point down and we should have to tie him on.

When we get a flying-machine that will take us to the moon, I shall want to alight well up on the top side for fear I shall fall off. In fact, landing on the under side would seem a physical impossibility. I try to fancy how it would seem if we could alight there. Of course, the sky would still be overhead and we should look up to that bigger moon, the earth,

from which we had just come on an upward flight. We go up to the moon or to Mars, and we turn round and look up to the point of our departure! It is the apparent contradiction that I cannot adjust my mind to; that up and down, over and under, can be abolished, that they are only forms of our experience, and that out in sidereal space they would have no meaning; that is something hard for us to realize. We apprehend it without comprehending it. Are all our notions thus relative? The globe is bigger than our minds. We cannot turn the cosmic laws round in our thoughts. We are adjusted to the sphere, not it to us.

If the moon were to break from its orbit and fall to the earth, its course would be downward, like that of the shooting stars. How would it seem to people on the moon, if there were people there?

This sense of contradiction that we feel in trying to adjust our minds to the idea of a round world, may be analogous to the difficulty we have in trying to reach an intellectual concept of the universe as a whole, or of certain of its parts and processes, such as the question of the nature and origin of life, or the immortality of the soul. Our minds are so constituted and disciplined by our experience that we look for the causes of every event or thing. We make a chain of causes, the end of which we never reach. A causeless event, or thing, we cannot think of any more than we can think of a stick with only

one end. God is unthinkable, because He is causeless.

The earth is so big that all our acquaintance with size avails us not — it is infinite to our senses — the question of size or of form never occurs. We cannot think "earth" as it is, any more than we can "becoming," or "evolution," or "motion." When we think "earth," we see a globe like the moon, or larger, with a top and bottom side; the earth has no sides, no boundary lines, or form bounded by right lines; it is all surface to which there are no boundaries.

To our senses the bullet-like speed of the earth through space amounts to absolute rest, and its revolution on its axis is motion on such a scale that we are quite unconscious of it. Just as its spherical shape, to our senses, becomes a boundless plain, so its huge silent motion through the great void is equivalent to eternal rest. We are only conscious of motion when we see or feel something that is not in motion, but on this earth, where is the fixed point? All is fixed, yet all is in motion. Drifting with the tide on the river, your boat seems at rest till you look shoreward; but drifting on the earth, where is the shore to look to? Those bright points in the heavens are drifting also, but they are so far from us that we cannot gauge our yearly motion by them, nor theirs by ours; with reference to them, we seem anchored in absolute space. Our diurnal motion

reveals itself only as a slow wheeling of the heavens around us. It is science that opens our mental vision to the true character of the earth we inhabit, and corrects the false impressions of our senses. So it is philosophy that sets us right about the world within us, and shows the true relation of our thoughts and experiences to larger impersonal truths.

We cannot penetrate the final mystery of things, because behind every mystery is another mystery. What causes life? What started evolution? Why are you and I here? Who or what ordered the world as we see it? We cannot help asking these questions, though we see when we try to take the first step that they are unanswerable. When we find the end or the under side of the sphere, we may hope to answer them. There is no ending, and no beginning, there is no limit to space or to time, though we make our heads ache trying to think how such can be the case. There is no final Cause in any sense that comes within the range of our experience in this world. We are prisoners of the sphere on which we live, and its bewildering contradictions are reflected in our mental lives as well.

XIII

A HAY-BARN IDYL

EVERY farm boy knows how much wild life ebbs and flows about a country hay-barn the whole year round. It is a point in the landscape where the wild and the domestic meet. The foxes prowl around it in winter, the squirrels visit it, mice and rats make their homes in it, and cut their roads through the hay. In summer swallows, phœbe-birds, and robins love to shelter their nests beneath its roof, bumblebees build their rude combs in the abandoned mice-nests, and yellow-jackets often hang their paper habitations from its timbers.

For several summers, as I have said in a former chapter, I have had my study in one of these empty or partly filled hay-barns on the farm where I was born, and the wild life about me that used to interest me as a boy now engages me as a student and observer of outdoor nature. While I am busy with my books and my writing, the birds are busy with their nest-building or brood-rearing. Now, in early July, a pair of barn swallows have a nest in the peak at one end, and a pair of phœbe-birds have a nest in the peak at the other end. The phœbes, remembering perhaps their ill luck last

year, when their nest and eggs were buried by the hay-gatherers, have established themselves in a swallow's old nest far above any possibility of being engulfed by the rising tide of hay. They have evidently refurnished the nest, but its exterior is quite destitute of the moss with which they always face their structures. I see the row of heads of the young above the brim, as I see a row of heads of young swallows above the brim of their nest. The swallows evidently look upon the phœbes as intruders. Maybe the fact that the phœbes have appropriated a swallow's last year's nest rankles a little. At any rate, many times during the day the male swallow swoops spitefully down at the phœbes as they sit upon the beams hesitating in my presence to approach their nest with food in their beaks.

The swallow is not armed for battle; in both beak and claw he is about the weakest of the weak; only in speed and skill of wing is he almost unrivaled, and he flashes those long, slender, sabre-colored wings about the heads of his plain unwelcome neighbors in a way that keeps them on the alert, but never provokes them to retaliation. The phœbes incline this way and that to avoid the blows, but make no sound and raise no wing in defense. They seem to know what a big "bluff" the swallows are putting up, or else how unequal a wing contest with them would be.

The phœbes are much more sensitive to my presence than are the swallows; they will not betray the secret of their nest to me while I am watching them. Whereas the swallows sweep in boldly over my head through the wide-open doors, and, in a swift upward curve, touch at the nest and are out again like spirits, the phœbes enter slyly, through small openings in the weather-boards, and alight upon a beam and look the ground over before they approach the nest.

The other day in my walk I came upon two phœbes' nests under overhanging rocks, both with half-fledged young in them, and in neither case were the parent birds in evidence. They did not give their secret away by setting up the hue and cry that nesting birds usually set up on such occasions. I finally saw them, as silent as shadows, perched near by, with food in their beaks, which they finally swallowed as my stay was prolonged. And the nests, both on a level with my eye, were apparently filled only with a motionless mass of bluish mould. As I gently touched them, instead of four or five heads with open mouths springing up, the young only settled lower in the nest and disposed themselves in a headless, shapeless mass. The phœbe is evidently a very cautious bird, though none is more familiar about our porches and outbuildings.

What a contrast they present in habits and manners with the swallows! — the plebeian phœbe, plain of dress, homely of speech, with neither grace of form

nor of movement, yet endeared to us by a hundred associations. The swallow has the grace of form and power of wing of the tireless sea-birds, and is almost as helpless and awkward on its feet as are some of the latter. The pair I am watching flash out and in the old barn like streaks of steel-blue lightning. I watch them hawking for insects over a broad meadow of timothy grass that slopes up to the woods that crown the hill. The mother bird is the more industrious; she makes at least three times as many trips in the course of an hour as does her mate; whether she returns with as loaded a beak or not, I have no means of knowing, but would wager that she does. Among nearly all species of birds the mother is the main bread-winner. I have recently had under observation a nest of young bluebirds in a cavity made by a downy woodpecker in a small birch-tree, a section of which I brought from the woods last fall and fastened up to one corner of my porch. The mother bird had entire care of the brood, bringing food every few minutes all day long. Not till the last day that the young were in the nest did the male appear, and then he took entire charge, and the mother either went off on a holiday, or else some untoward fate befell her.

I look up from my writing scores of times during the day to see the two swallows coursing low over the meadow of rippling daisies and timothy, tacking, darting, rising, falling, now turning abruptly, now

sweeping in wide circles, and, having secured the invisible morsel, coming down grade into the barn with the speed of arrows. A row of expectant heads, four or five of them, arranged along the wide opening of the nest await them. It is touch and go, no tarrying; the gnat or the fly is deposited in an open mouth as swiftly as it is caught. The beaks of all the young open as the swift wings of the parent bird are heard, and a subdued chippering and squeaking follows. That there is any method in the feeding, or that they are fed in regular order, I cannot believe. Which of the young will get the next morsel is probably a matter of chance, but doubtless the result averages up very evenly in the course of an hour or two.

The wing-power expended by the parent birds in this incessant and rapid flight must be very great, and one would think that all the insects captured would be required to keep it up. How fine and slight their prey seems to be! I may follow their course through the meadow with my head about as high above the grass as is their flight, and not see anything but an occasional butterfly or two — a game the swallows are not looking for. They hunt out something invisible to my eyes, something almost as intangible as the drifting flower pollen. Probably the finer it is, the more potent it is; a meal of gnats may be highly concentrated food. Now and then they probably capture a house-fly or other large in-

sect. To know how full the summer air is of fine, gauzy insects, look toward the sun of an afternoon where you have the shadow of a wood for a background. The sunlight falling on the wings of the tiny creatures seems greatly to magnify them, and one sees where the speeding swallows reap much of their harvest.

The phœbe, and all the true flycatchers, hunt in a much less haphazard way; like the hawks, they see their prey before they make their swoop; they are true sportsmen and their aim is sure. Perched here and there, they wait for their game to appear. But the swallows hurl themselves through the air with tremendous speed and capture what chances to cross their paths — a feat quite impossible to the regular flycatcher.

On calm days they hawk high; on windy days their prey flies near the earth and they hunt low. How random and wayward their course is, but what freedom and power of wing it discloses! A poet has called them skaters in the field of air, but what skater can perform such gyrations or attain such speed? Occasionally on windy days they seem to dip and turn, or check themselves, as if they saw an individual insect and paused to seize it. But for the most part they seem to strain the air through their beaks and seize what it leaves them.

As the days pass, the young swallows begin to grow restless. I see them stretching their wings, with

their bodies half out of the nest. A day or two later I hear a fluttering sound over my head and look up to see one of them clinging to the outside of the nest and exercising his wings vigorously; for a few seconds he clings there and makes his wings hum; the flying impulse is working on him, and soon it will launch him forth upon the air. Two or three times a day I see this feat repeated. The young are doubtless all taking turns in trying their wings to see if they are as recommended. Then the parents come in, evidently with empty beaks, and take turns in hovering in front of the nest and saying, "Wit, wit," approvingly and encouragingly, and then flying about the empty barn or making a dash at phœbe as she sits with flipping tail on a beam. Presently they resume their feeding. The next day there is more wing exercise by the young, and more hovering and chirping about the nest by the parents. Sometimes the latter sit quietly upon a beam, and then the male flies up and clings for a moment to the side of the nest, and squeaks softly and lovingly. I think the great event, the first flight of the young, is near at hand. I go to dinner and when I return and am about to enter the barn, the mother swallow sweeps down toward me and calls "Sleet, sleet," which I take to be her way of saying "Scat, scat," and I know something has happened. Looking up to the roof, I see one of the young perched upon it a few inches from the lower edge. He looks scared and

ill at ease. I cast a pebble above him and away he goes into the free air, his parents wheeling about him, and leading him on in an evident state of excitement. How well he used his wings on that first flight, swooping and soaring with but little appearance of awkwardness or hesitation! After a few moments he comes back to the barn roof and alights on the other side beyond my sight. During the afternoon the other three venture out at intervals and fly about the interior of the barn for some time before venturing outside, their parents flying with them and cheering encouragingly.

When once launched on the wing, the next great problem with them seemed to be how to alight. It was evidently a trying problem. They would make feints at stopping upon this beam or upon that, but could not quite manage it till, in an awkward manner, they would flop down somewhere. In a good many things we ourselves find it more difficult to stop than to start. In the course of the afternoon they all went forth into the air with their parents, and, I think, never returned to the interior of the barn. At five o'clock I saw them perched upon the tops of dry mullein-stalks in the pasture. As I approached them, they took flight and coursed through the air high and low, over the tree-tops and above the valley, with wonderful ease and freedom. After a while they returned to the mullein-stalks and again betrayed their inexperience by their awkwardness

in alighting. It would be interesting to know how long they were on the wing before they began capturing their own food. I saw the parent birds feeding them in the air a few days after the exodus from the nest. In August they will be perching upon telegraph-wires and upon the ridgepoles of hay-barns, with the instinct of migration working in their little bodies.

The exodus of the young phœbes from the nest was much less noticeable. I saw no preliminary stretching or flapping of wings, and no parental solicitude. Flying is not the business of the phœbe, as it is with the swallow, and its life is much more humdrum. The young came out at intervals one afternoon, and they lingered about the barn, going out and in for several days, the family keeping well together. Later I shall see them about the orchards and fences, bobbing their tails and being fed by their parents.

A mow of last year's hay in the big bay of the barn holds its pretty secret also. Two years ago a junco or snowbird built her nest in its side, and this year she, or another, is back again, a month earlier. It amuses me to see her come in with her beak full of dry grass to build a nest in a mow of dry grass. Her forebears have always built their nests in the sides of weedy or mossgrown banks in secluded fields and woodsides, and have used such material as they could find in these places. She is under the spell of

these inherited habits — in all but in the selection of the locality of her nest. In this she makes a new departure, and in so doing shows how adaptive many of the wild creatures are. The bird has probably failed in her attempts to bring out a brood in the old places. I think three out of four of all such attempts on the part of ground builders do fail. Within a few days two sparrows' nests in a small space in the pasture below me have been "harried," as the Scotch say. If they escape the sharp-eyed crows by day, the skunks and the foxes, or other night prowlers, are pretty sure to smell them out by night. The family of crows, two old ones and four young ones, that I see every day foraging about the fields, probably plunder nine out of ten of all the nests in the field. At any rate, my junco has decided on trying the shelter of the old barn. Here she is in danger from rats and cats and red squirrels, but at this season she stands a fair chance of escape. When she comes in with a wisp of the outdoor rubbish in her beak, I should say she showed some nervousness were it not for the fact that juncoes always seem to be nervous. She flits about with her eye upon me, and after a few feints flies up to her place on the side of the mow and disappears for a moment under the drooping locks of hay. Her nest is completed in two or three forenoons — a very simple and rude affair compared with the nest in May or June under a mossy bank by the woodside. Then she is not in evidence

for two or three days, when, one morning, I discover that the nest holds two eggs. Two days later it holds four, and the next day incubation has evidently begun. As she sits in the shadow of her little cavity in the mow, only her light-colored beak shows me when she is on her nest. A heavy rope is stretched low across the barn floor, and it is a pretty sight to see her approach the hay-mow along this rope, hopping nervously along, showing the white quills in her tail, and wiping her beak over and over on the rope as she progresses. I think the beak-wiping, now on this side, now on that, is just another expression of her nervousness, or else of preoccupation, for surely her beak is clean. She gives no heed either to the swallows or to the phœbes, nor they to her. Well, she is fairly launched on her little voyage of maternity, and I shall do all I can to see that her venture is successful.

A week later, alas! it turned out to be the old story of the best-laid schemes of mice and men. Some serious mishap befell my little neighbor. One day she was missing from her nest from morning till night. The following morning her eggs were stone cold, and the male bird was flitting about the barn and running along the beams as I entered, no doubt in an anxious state of mind about his mate. I could give him no clue to her whereabouts, and her fate is a mystery — whether captured, by a hawk or a cat, while out in quest of food, I shall never know.

The same day ill fortune overtook a queen bumblebee who had a nest somewhere about the barn. She appeared abruptly upon the ground in front of my door in a great state of excitement. She seemed suddenly to have discovered that she could not fly, and she was making vain attempts to do so, in a state of painful agitation. She buzzed and rushed about amid the dry grass and loose straws like one beside herself. I went to her to give her a lift; she rushed up the twig I proffered, then up my hand, shaking with excitement. From this coign of vantage she tried to launch herself into the air, but fell ingloriously to the ground. I saw that her right wing was badly mutilated; not more than half of it remained, and flying was out of the question. But the poor queen would not have it so; she could not be convinced that she could not fly. The oftener she failed in her attempts, the more desperate she became. She always had flown, and now suddenly her wings failed her. She would climb up the taller spears of grass and make the attempt, and upon stems and sticks. She could not accept her cruel fate. She finally rushed into the stonework and I saw her no more.

I am not certain that the queen bumblebee makes a nuptial flight like the queen of the hive bees, but probably she does, and this one may have left her near-by colony for this purpose, only to flounder ingloriously among the weeds. Probably some anarchist insect had frayed and clipped her wing in

her nest, having no more respect for royalty than for her humble subjects. There is no sphere of life so lowly that such tragedies and failures do not come to it.

XIV

IN FIELD AND WOOD

I. INTENSIVE OBSERVATION

THE casual glances or the admiring glances that we cast upon nature do not go very far in making us acquainted with her real ways. Only long and close scrutiny can reveal these to us. The look of appreciation is not enough; the eye must become critical and analytical if we would know the exact truth.

Close scrutiny of an object in nature will nearly always yield some significant fact that our admiring gaze did not take in. I learned a new fact about the teazel the other day by scrutinizing it more closely than I had ever before done; I discovered that the wave of bloom begins in the middle of the head and spreads both ways, up and down, whereas in all other plants known to me with flowering heads or spikes, except the goldenrod and the steeplebush, the wave of bloom begins at the bottom and creeps upward like a flame. In the goldenrod it drops down from branch to branch. In vervain, in blueweed, in Venus' looking-glass, in the mullein, in the evening-primrose, and others, the bloom creeps slowly upward from the bottom.

But with the teazel the flame of bloom is first kindled in the middle; to-day you see the head with this purple zone or girdle about it, and in a day or two you see two purple girdles with an open space between them, and these move, the one up and the other down, till the head stands with a purple base and a purple crown with a broad space of neutral green between them.

This is a sample of the small but significant facts in nature that interest me — exceptional facts that show how nature at times breaks away from a fixed habit, a beaten path, so to speak, and tries a new course. She does this in animal life too.

Huxley mentions a curious exception to the general plan of the circulation of the blood. In all animals that have a circulation the blood takes one definite and invariable direction except in the case of one class of marine animals, called ascidians; in them the heart, after beating a certain number of times, stops and begins to beat the opposite way, so as to reverse the current; then in a moment or two it changes again and drives the blood in the other direction.

All things are possible with nature, and these unexpected possibilities or departures from the general plan are very interesting. It is interesting to know that any creature can come into being without a father, but with only a grandfather, yet such is the case. The drone in the hive has no father; the

eggs of the unfertilized queen produce drones — that is, in producing males, the male is dispensed with. It is to produce the neuters or the workers that the service of the male is required. The queen bee is developed from one of these neuter eggs, hence her male offspring have only a grandfather.

The chipmunk is an old friend of my boyhood and my later years also, but by scrutinizing his ways a little more closely than usual the past summer I learned things about this pretty little rodent that I did not before know. I discovered, for instance, that he digs his new hole for his winter quarters in midsummer.

In my strolls afield or along the road in July I frequently saw a fresh pile of earth upon the grass near a stone fence, or in the orchard, or on the edge of the woods — usually a peck or two of bright, new earth carefully put down in a pile upon the ground without any clue visible as to where it probably came from. But a search in the grass or leaves usually disclosed its source — a little round hole neatly cut through the turf and leading straight downward. I came upon ten such mounds of earth upon a single farm, and found the hole from which each came, from one to six feet away. In one case, in a meadow recently mowed, I had to explore the stubble with my finger over several square yards of surface before I found the squirrel's hole, so undisturbed was the grass around it; not a grain of soil

had the little delver dropped near it, and not the slightest vestige of a path had he made from the tunnel to the dump.

And this feature was noticeable in every case; the hole had been dug several yards under ground and several pecks of fresh earth removed to a distance of some feet without the least speck of soil or the least trace of the workman's footsteps showing near the entrance; such clean, deft workmanship was remarkable. All this half-bushel or more of earth the squirrel must have carried out in his cheek pockets, and he must have made hundreds of trips to and fro from his dump to his hole, and yet if he had flown like a bird the turf could not have been freer from the marks of his going and coming; and he had cut down through the turf as one might have done with an auger, without bruising or disturbing in any way the grass about the edges. It was a clean, neat job in every case, so much so that it was hard to believe that the delver did not come up from below and have a back door from whence he carried his soil some yards away.

Indeed, I have heard this theory stated. "Look under the pile of earth," said a friend who was with me and who had observed the work of the pocket gopher in the West, "and you will find the back door there." But it was not so. I carefully removed four piles of earth and dug away the turf beneath them, and no hole was to be found.

One day we found a pile of earth in a meadow, and near it a hole less than two inches deep, showing where the chipmunk had begun to dig and had struck a stone; then he went a foot or more up the hill and began again; here he soon struck stones as before, then he went still farther up the hill, and this time was successful in penetrating the soil. This was conclusive proof that these round holes are cut from above and not from below, as we often see in the case of the woodchuck-hole. The squirrel apparently gnaws through the turf, instead of digging through, and carries away the loosened material in his mouth, never dropping or scattering a grain of it. No home was ever built with less litter, no cleaner dooryard from first to last can be found.

The absence of anything like a trail or beaten way from the mound of earth to the hole, or anything suggesting passing feet, I understood better when, later in the season, day after day I saw a chipmunk carrying supplies into his den, which was in the turf by the roadside about ten feet from a stone wall. He covered the distance by a series of short jumps, apparently striking each time upon his toes between the spears of grass, and leaving no marks whatever by which his course could be traced. This was also his manner of leaving the hole, and doubtless it was his manner in carrying away the soil from his tunnel to the dumping-pile. He left no sign upon

the grass, he disturbed not one spear about the entrance.

There was a mystery about this den by the roadside of which I have just spoken — the pile of earth could not be found; unless the roadmaker had removed it, it must have been hidden in or beneath the stone wall.

And there was a mystery about some of the other holes that was absolutely baffling to me. In at least four mounds of fresh earth I found freshly dug stones that I could not by any manipulation get back into the hole out of which they had evidently come. They were all covered with fresh earth, and were in the pile of soil with many other smaller stones. In one case a stone two inches long, one and one half inches broad, and one half inch thick was found. In two other cases stones of about the same length and breadth but not so thick were found, and in neither case could the stone be forced into the hole. In still another case the entrance to the den was completely framed by the smaller roots of a beech-tree, and in the little mound of earth near it were two stones that could only be gotten back into the hole by springing one of these roots, which required considerable force to do. In two at least of these four cases it was a physical impossibility for the stones to have come out of the hole from whence the mound of earth and the lesser stones evidently came, yet how happened they in the pile of earth

freshly earth-stained? The squirrel could not have carried them in his cheek pouches, they were so large; how, then, did he carry them?

The matter stood thus with me for some weeks; I was up against a little problem in natural history that I could not solve. Late in November I visited the scene of the squirrel-holes again, and at last got the key to the mystery: the cunning little delver cuts a groove in one side of the hole just large enough to let the stone through, then packs it full of soil again. When I made my November visit it had been snowing and raining and freezing and thawing, and the top of the ground was getting soft. A red squirrel had visited the hole in the orchard where two of the largest stones were found in the pile of earth, and had apparently tried to force his way into the chipmunk's den. In doing so he had loosened the earth in the groove, softened by the rains, and it had dropped out. The groove was large enough for me to lay my finger in and just adequate to admit the stones into the hole. This, then, was the way the little engineer solved the problem, and I experienced a sense of relief that I had solved mine.

I visited the second hole where the large stone was in the pile of earth, and found that the same thing had happened there. A red squirrel, bent on plunder, had been trying to break in, and had removed the soil in the groove.[1]

[1] I feel bound to report that the next season I found a pile

To settle the point as to whether or not the chipmunk has a back door, which in no case had I been able to find, we dug out the one by the roadside, whose mound of earth we could not discover. We followed his tortuous course through the soil three or four feet from the entrance and nearly three feet beneath the surface, where we found him in his chamber, warm in his nest of leaves, but not asleep. He had no back door. He came out (it was a male) as a hand was thrust into his chamber, and the same fearless, strong hand seized him, but did not hurt him. His chamber was spacious enough to hold about four quarts of winter stores and leave him considerable room to stir about in. His supplies consisted of the seeds of the wild buckwheat (*Polygonum dumetorum*) and choke-cherry pits, and formed a very unpromising looking mess. His buckwheat did not seem to have been properly cured, for much of it was mouldy, but it had been carefully cleaned, every kernel of it. There were nearly four quarts of seeds altogether, and over one half of it was wild buckwheat. I was curious to know approximately the number of these seeds he had gathered and shucked. I first found the number it took to fill a lady's thimble, and then the number of thimbles

of earth which a chipmunk had removed from his den, containing a stone too large to go into the hole, yet the most careful examination failed to reveal that there had ever been any groove cut in it, or that it had ever been in any way enlarged.

full it took to fill a cup, and so reached the number in the two quarts, and found that it amounted to the surprising figure of 250,000.

Think of the amount of patient labor required to clean 250,000 of the small seeds of the wild buckwheat! The grains are hardly one third the size of those of the cultivated kind and are jet black when the husk is removed. Probably every seed was husked with those deft little hands and teeth as it was gathered, before it went into his cheek pockets, but what a task it must have been!

Poor little hermit, it seemed pathetic to find him facing the coming winter there with such inferior stuff in his granary. Not a nut, not a kernel of corn or wheat. Why he had not availed himself of the oats that grew just over the fence I should like to know. Of course, the wild buckwheat must have been more to his liking. How many hazardous trips along fences and into the bushes his stores represented! The wild creatures all live in as savage a country as did our earliest ancestors, and the enemy of each is lying in wait for it at nearly every turn.

Digging the little fellow out, of course, brought ruin upon his house, and I think the Muse of Natural History contemplated the scene with many compunctions of conscience,—if she has any conscience, which I am inclined to doubt. But our human hearts prompted us to do all we could to give the provident little creature a fresh start; we put his

supplies carefully down beside the stone wall into which he had disappeared on being liberated, and the next day he had carried a large part of them away. He evidently began at once to "hustle," and I trust he found or made a new retreat from the winter before it was too late.

I doubt if the chipmunk ever really hibernates; the hibernating animals do not lay up winter stores, but he no doubt indulges in many very long before-dinner and after-dinner naps. It is blackest night there in his den three feet under the ground, and this lasts about four months, or until the premonitions of coming spring reach him in March and call him forth.

I am curious to know if the female chipmunk also digs a den for herself, or takes up with one occupied by the male the previous winter.

One ought to be safe in generalizing upon the habits of chipmunks in digging their holes, after observing ten of them, yet one must go slow even then. Nine of the holes I observed had a pile of earth near them; the tenth hole had no dump that I could find. Then I found four holes with the soil hauled out and piled up about the entrance precisely after the manner of woodchucks. This was a striking exception to the general habit of the chipmunk in this matter. "Is this the way the female digs her hole," I asked myself, "or is it the work of young chipmunks?"

I have in two cases found holes in the ground on

the borders of swamps, occupied by weasels, but the holes were in all outward respects like those made by chipmunks, with no soil near the entrance. The woodchuck makes no attempt to conceal his hole by carrying away the soil; neither does the prairie-dog, nor the pocket gopher. The pile of telltale earth in each case may be seen from afar, but our little squirrel seems to have notions of neatness and concealment that he rarely departs from. The more I study his ways, the more I see what a clever and foxy little rodent he is.

II. FROM A WALKER'S WALLET

I

On the morning after our first hard frost in late October or early November how rapidly the leaves let go their hold upon their parent stems! I stood for some minutes one such morning under a maple by the roadside to witness the silent spectacle. The leaves came down one by one like great golden flakes; there was no motion in the air to loosen them; their hour had come, and they gave up life easily and gracefully.

What a gay company they had made on that tree all summer, clapping their hands in gladness, and joyously drinking in the air and the sunshine, whispering, rustling, swayed by emotion, or stilled by the night dews, and each and all doing their work! Now

their day is done, and one by one they let go their hold upon the parent stem, and fall to the earth.

Some come hurrying and tumbling down; some drop almost like clods; some come eddying and balancing down; and now and then one comes down as gracefully as a bird, sailing around in an easy spiral like a dove alighting, its edges turned up like wings, and its stems pointing downward like a head and neck. One can hardly believe it is not a thing of life. It reaches the ground as lightly as a snowflake. If one could only finish his own career as gracefully!

What a contrast to the falling of the leaves of some other trees, say those of the mulberry! The leaves of this tree fall, on such mornings, like soldiers slain in battle with all their powers in full force. They drop heavily and clumsily, apparently untouched by the ripening process that so colors the maple and other leaves. They are rank green and full of sap. So with the locusts, and the apple and cherry leaves; they all seem cut off prematurely.

But the leaves of most of our native trees — oak, ash, hickory, maple — seem to fall in the fullness of time. They have ripened like the grain and the fruit; they are colored like the clouds at sunset; and their demise seems a welcome event. They make the woods and groves gay; they carpet the ground as with sunset clouds; it is a funeral that is like a festival; it is the golden age come back.

The falling of these gayly colored leaves seems to

make a holiday in nature; it is like the fluttering of ribbons and scarfs; it does not suggest age and decay; it suggests some happy celebration. They seem to augment the sunshine, to diffuse their own color into it, or to give back to it the light they have been so long absorbing. The day itself drops upon the earth like a great golden leaf fallen from the tree of Ygdrasyl.

II

It always gives me a little pleasurable emotion when I see in the autumn woods where the downy woodpecker has just been excavating his winter quarters in a dead limb or tree-trunk. I am walking along a trail or wood-road when I see something like coarse new sawdust scattered on the ground. I know at once what carpenter has been at work in the trees overhead, and I proceed to scrutinize the trunks and branches. Presently I am sure to detect a new round hole about an inch and a half in diameter on the under side of a dead limb, or in a small tree-trunk. This is Downy's cabin, where he expects to spend the winter nights, and a part of the stormy days, too.

When he excavates it in an upright tree-trunk, he usually chooses a spot beneath a limb; the limb forms a sort of rude hood, and prevents the rain-water from running down into it. It is a snug and pretty retreat, and a very safe one, I think. I doubt whether

the driving snow ever reaches him, and no predatory owl could hook him out with its claw. Near town or in town the English sparrow would probably drive him out; but in the woods, I think, he is rarely molested, though in one instance I knew him to be dispossessed by a flying squirrel.

On stormy days I have known Downy to return to his chamber in mid-afternoon, and to lie abed there till ten in the morning.

I have no knowledge that any other species of our woodpeckers excavate these winter quarters, but they probably do. The chickadee has too slender a beak for such work, and usually spends the winter nights in natural cavities or in the abandoned holes of Downy.

III

As I am writing here in my study these November days, a downy woodpecker is excavating a chamber in the top of a chestnut post in the vineyard a few yards below me, or rather, he is enlarging a chamber which he or one of his fellows excavated last fall; he is making it ready for his winter quarters. A few days ago I saw him enlarging the entrance and making it a more complete circle. Now he is in the chamber itself working away like a carpenter. I hear his muffled hammering as I approach cautiously on the grass. I make no sound and the hammering continues till I have stood for a moment beside the

post, then it suddenly stops and Downy's head appears at the door. He glances at me suspiciously and then hurries away in much excitement.

How did he know there was some one so near? As birds have no sense of smell it must have been by some other means. I return to my study and in about fifteen minutes Downy is back at work. Again I cautiously and silently approach, but he is now more alert, and when I am the width of three grape rows from him he rushes out of his den and lets off his sharp, metallic cry as he hurries away to some trees below the hill.

He does not return to his work again that afternoon. But I feel certain that he will pass the night there and every night all winter unless he is disturbed. So when my son and I are passing along the path by his post with a lantern about eight o'clock in the evening, I pause and say, "Let's see if Downy is at home." A slight tap on the post and we hear Downy jump out of bed, as it were, and his head quickly fills the doorway. We pass hurriedly on and he does not take flight.

A few days later, just at sundown, as I am walking on the terrace above, I see Downy come sweeping swiftly down through the air on that long galloping flight of his, and alight on the big maple on the brink of the hill above his retreat. He sits perfectly still for a few moments, surveying the surroundings, and, seeing that the coast is clear, drops quickly and

silently down and disappears in the interior of his chestnut lodge. He will do this all winter long, coming home, when the days are stormy, by four o'clock, and not stirring out in the morning till nine or ten o'clock. Some very cold, blustery days he will probably not leave his retreat at all.

He has no mate or fellow lodger, though there is room in his cabin for three birds at least. Where the female is I can only conjecture; maybe she is occupying a discarded last year's lodge, as I notice there are a good many new holes drilled in the trees every fall, though many of the old ones still seem intact.

During the inclement season Downy is anything but chivalrous or even generous. He will not even share with the female the marrow bone or bit of suet that I fasten on the maple in front of my window, but drives her away rudely. Sometimes the hairy woodpecker, a much larger bird, routs Downy out and wrecks his house. Sometimes the English sparrows mob him and dispossess him. In the woods the flying squirrels often turn him out of doors and furnish his chamber cavity to suit themselves.

IV

I am always content if I can bring home from my walks the least bit of live natural history, as when, the other day, I saw a red-headed woodpecker having a tilt with a red squirrel on the trunk of a tree.

Doubtless the woodpecker had a nest near by, and

had had some experience with this squirrel as a nest-robber. When I first saw them, the bird was chasing the squirrel around the trunk of an oak-tree, his bright colors of black and white and red making his every movement conspicuous. The squirrel avoided him by darting quickly to the other side of the tree.

Then the woodpecker took up his stand on the trunk of a tree a few yards distant, and every time the squirrel ventured timidly around where he could be seen the woodpecker would swoop down at him, making another loop of bright color. The squirrel seemed to enjoy the fun and to tempt the bird to make this ineffectual swoop. Time and again he would poke his head round the tree and draw the fire of his red-headed enemy. Occasionally the bird made it pretty hot for him, and pressed him closely, but he could escape because he had the inside ring, and was so artful a dodger. As often as he showed himself on the woodpecker's side, the bird would make a vicious pass at him; and there would follow a moment of lively skurrying around the trunk of the old oak; then all would be quiet again.

Finally the squirrel seemed to get tired of the sport, and ran swiftly to the top and off through the branches into the neighboring trees. As this was probably all the woodpecker was fighting for, he did not give chase.

While I was watching the squirrel and the woodpecker, I discovered a crow's nest with nearly grown young. The parent crow came low over the fence into the grove, and flew to a branch of an oak, and alighted only ten or twelve feet from the ground. Then it flew to a higher branch in another tree, and then to the top of a group of spruces, where I saw one of the young crows rise and take the food. How cautious and artful the whole proceeding was!

One of our latest nature writers pretends to see what the crow brings her young at such times. Had I had the most powerful opera-glasses on this occasion, I could not have told the nature of the morsel she brought in her beak. The thing is done very quickly and deftly, and is not meant for the eye of any onlooker there may chance to be about.

Thus all the little ways and doings of the birds interest me. They are curiously human, while yet they afford glimpses into a new and strange world. We look on; we are interested; we understand; we sympathize; we may lend a hand; we share much in common; one nature mothers us all; our lives run parallel in many respects; similar problems, similar needs, similar fatalities, similar tribulations, come home to us all; and yet we are separated by a gulf, the gulf that lies between conscious, reasoning soul and unconscious, unreasoning instinct. But I must not plunge into the gulf, nor seek to clear it here.

V

It always amuses me to see in late May a "chippy" or a goldfinch ride down the dandelion stalk that is carrying its frail globe of down high above the grass. You are looking out over the lawn when you see one of these silver balls suddenly go down. A chippy or a goldfinch has thrown itself upon the stalk and borne it to the ground for the seed.

The dandelion seeds are about the first that ripen, and the seed-eating birds are hard put for food at this time. Hence these globes are a godsend to them. Not long before I had seen the goldfinches and the purple finches pecking to pieces the button-balls of the sycamore for the seeds they held, put up so compactly.

In May the squirrels are hard put also. It is at this season that the chipmunk pulls up the corn, and that the red squirrel robs the birds' nests of both eggs and young. Their last year's stores of nuts and grains are exhausted, and the new crop is not yet formed. I think that the chipmunk has learned that there is something for him also in the dandelion seed, but I doubt whether the red squirrel has.

The latter has found out that there is something for him in the seeds of the elm-tree, which usually get fully developed in May. The elm affords short commons, but it is better than nothing. The chaff is big and the grain small, but probably sweet.

Morning, noon, and night I see the squirrels feeding in the elms about my cabin, and see the road strewn with the elm-flakes from which the germ in the centre has been cut.

Do they know an elm-tree when they see it, or do they explore all the trees in quest of food? If, again, I belonged to the new school of nature writers, I should say they know an elm as well as you or I, and the date on which the seeds are edible, and that they taught this wood-lore to their young. But, as it is, I will only venture to say that at this season there they are in the topmost branches of the scattered elms, very busy with these green scales, reaching and swaying and hanging by their hind feet, or sitting up in that pretty way with tails over backs and hands deftly submitting the samara to the teeth.

The red squirrel is much more of a "hustler" than is the gray, and will make shift to live where the latter will starve. The red squirrel abides, while the gray seems to go and come with the seasons of scarcity or of plenty. Yet I have seen the gray eating the fruit of the poison-ivy and apparently relishing it. But he rarely disturbs the birds, though of this misdemeanor he is probably not entirely innocent.

Small things, small doings, train our powers of observation. The big things all can see. Who sees the finer, shyer play of wild life that goes on about us? Not all of nature's book is writ large; the fine

print is quite as interesting, and it is this that trains the eye.

A schoolgirl wrote me one day that she had seen a hawk carrying a snake in its beak. Now, if she had had a trained eye, she would have seen that the hawk carried the snake in its talons. One of our recent nature writers has made the same mistake in his book. Birds of prey all carry their game in their talons; other birds carry it in their beaks.

A recent magazine writer errs in the other direction when he makes the crow carry in its claws the corn it has pulled up, as the crow is one of the birds that carries everything in its beak.

Emerson says, "The day does not seem wholly profane in which we have given heed to some natural object." It is such little incidents as I have been relating that redeem many of my own days, and give to my pastimes a touch of something I would not willingly miss from them.

III. MEN AND ANIMALS

I

While listening to the house wren one morning repeating its song eight or ten times a minute for hours at a stretch, and with an expenditure of force doubtless many times greater, considering its size, than that expended by a man or woman in the act of singing, and knowing, as I did, that the little bird

would keep up the outpouring of song continuously for two or three months, throbbing and shaking in ecstasy like a small dynamo, I was forcibly reminded of some of the less obvious but deep-seated differences between ourselves and what we call the lower animals, or of the action of instinct in the one case, and the action of conscious intelligence in the other.

In this matter of song lies one of these differences. The bird-song is much less a deliberate performance than the human song, and is one of the secondary sexual characteristics of birds. It is the badge of the male alone, like the gay plumes, and is for the most part confined to the breeding-season.

To our ears it is expressive of joy, hilarity, ecstasy, but it probably no more has its origin in those emotions than the gay plumes do. Its origin is in the male sexual principle; it is one of the surplusages of nature.

Fine gifts of song and brilliant plumage rarely go together, as if both sprang from the same inward necessity, and each precluded the other. Our gem-like indigo-bird, for instance, is a faithful midsummer songster, but in sweetness and tenderness how far his strain falls short of that of the little brown bush sparrow in the same field or bramble-patch!

But I was thinking more especially of the automatic character of bird-songs. Their character in this respect is so marked that they often remind me

of the artificial songbirds made in Paris or Switzerland, which, when wound up, really sing with spirit and sweetness. In their season most of our birds sing as if they also went by a kind of clockwork.

They are wound up to go so long, usually two or three months. Late in June they begin to show signs of running down, and by and by we get only little snatches and fragments of song from them. In May, for instance, the song of the bobolink is full and rollicking, "a brook o' laughter," as Lowell says, running down the air. But in July the brook, like our mountain streams during a dry time, has so nearly dried up that we get only interrupted and fragmentary trickles now and then.

Moreover, a bird-voice has a kind of mechanical uniformity and tirelessness; it seems as incapable of fatigue or failure of any kind as does a clock. One would as soon expect a bell or a watch or a meter to get hoarse or tired as he would expect such a thing of any of our wild sweet singers. An amount of conscious effort with the voice on the part of a human being, equal to what each of our songbirds puts forth every day, would use up his strength, and his instrument, too, in a mere fraction of the time.

I have for two seasons timed the little bush sparrow as he sings about my vineyards, and found that for many hours a day, and every day in the month, from April to midsummer, he sings his song regularly six times a minute, making several thousand times

a day, extending, probably, over one hundred days.

The red-eyed vireo sings almost continuously throughout the greater part of the day, from May to September. During the midsummer days, as in my walk I pass along the road by a beech wood, I hear a red-eye singing, singing continuously till two or three o'clock in the afternoon. It is like a boy whistling at his work; only no boy could whistle so long and so uninterruptedly. He pauses only briefly now and then to catch and eat a worm. This done, he wipes his bill on a limb, and resumes his warble as he resumes his hunt. The vireo is wound up to go the whole season, and there is no failure, though during the latter part of the summer his warble is less continuous. When I time him I find he repeats his strain of three or four notes about every second, which, if he sang only five hours a day, would bring the number up into the tens of thousands, and the season of three or four months would bring it up into the millions. I have heard a phœbe-bird in the early July morning repeat her call every second from dawn to sunrise, probably two thousand times or more, morning after morning. When the mating fever is at its height in early June, I have heard the whip-poor-will vociferate its name eight or nine hundred times in as many seconds without the slightest pause.

One season an indigo-bird sang on the edge of the

wood where I passed daily from the middle of May to the middle of August. The favorite perch of the bird was on a dead branch in the top of a beech-tree, and on a particular part of the branch. Day after day and at different hours I noticed the little songster perched on his dead branch singing his brief, simple song. I know his mate had a nest somewhere in a low bush within earshot of the singer, but I failed to find it. Long after the young must have flown he kept up his song from the tree-top. In early August he was still singing six times a minute when he sang, but the intervals between his periods of song grew longer and longer. His store of musical energy was slowly running down. Not often now did he sing a minute at a time.

A song sparrow that sang near me during the morning hours through May, June, and July, and that had at least five distinct songs which he would sing one after the other, repeating each one from ten to twenty times, began to run down in August. His different songs lost their distinctness and emphasis. It was as if they had faded and become blurred.

Nearly all our songbirds are equally prodigal of song during the spring and early summer. It is the methodical and untiring character of a machine rather than conscious effort.

On the 25th of July at five in the afternoon I heard the hermit thrush repeating his strain with mechanical regularity ten times a minute. Undoubtedly he

had been doing it many hours a day since early May. On the same day I heard the indigo-bird repeating its song eight times a minute, many times during the day.

If music with the birds was an art that they learned as we do, and consciously practiced for their own and others' enjoyment, we should most assuredly have far less of it than we do. Reason tires and gives up much sooner than instinct.

Then, the musical talent is a fortuitous and uncertain thing with *Homo sapiens*, but it is constant and universal with the thrushes and sparrows and vireos. Every male bird of these species sings, and, except in rare instances, sings as well as its fellow.

Another fact that shows the automatic character of bird-songs is this: A bird with a defective voice, as occasionally happens, will sing as persistently and joyously in its period of song as its fellow with the perfect voice. I have heard a bobolink with a broken, wheezy, half-inarticulate voice hover and sing above the daisies and the clover as gleefully as the bird with a perfect instrument. It sang, not for its own edification or the edification of others, but because it had to. It was wound up to sing, and sing it must, be the result never so defective.

Music in the insect world is of a like automatic character. Their fiddles and harps and drums and cymbals and castanets are all set going by the season's warmth, and fail as the warmth fails, as surely

as the water-wheel stops when the dam is empty or the stream is dry. The katydid begins by vociferating "Katy did it," "Katy did it." A little later it says, "Katy did." After the first frost it says, "Katy," "Katy," and then finally, as October wanes, only a feeble, "Kate," "Kate."

Much of our own lives is undoubtedly merely automatic, the result of habit, of family, or of race traits, or of unconscious imitation; but with the lower orders of creation a much larger proportion, say ninety-nine parts in one hundred, is purely automatic, or the result of blind, inherited impulses.

II

Another particular in which man differs from all the orders below him is this: He has to learn what to eat, what is good for him. His dominant impulse as a baby is to put into his mouth everything he can seize, no matter what it is, stick or stone, food or fuel, tool or toy. He looks it over, and then into his mouth it goes. The impulse to feed is strong, but it is also blind.

The young of no other animal is such a blunderer, or so omnivorous a devourer. All other species seem to know their proper food instinctively, but man seems born with only the blind impulse to thrust all things into his mouth. And he has gone on thrusting all things into his mouth and surviving the experiment as best he may. There is no doubt what-

ever that he has fed upon many things, and is still feeding upon many things, that are injurious to him.

He makes dietetic mistakes that the lower orders never make. Each species knows its proper food from the jump, and all individuals of that species thrive equally well upon it. There are no eccentricities of taste or caprices of digestion among them. But with us what is one man's food is often another man's poison, and what one gloats over, another may abhor.

Man's stomach is the battle-ground of his life in a sense that is not true of the stomach of his dog or his horse in relation to their lives. It is doubtful whether any of the wild or self-fed creatures ever have indigestion or any of the many ills that human flesh is heir to. If given a chance, nearly all of the individuals of the same species live to the same age, be that long or short. There is no infant mortality among them as among us, except among the birds, which storms and cold often decimate.

It is a theory of mine that nearly all our ailments and distempers come by way of the mouth, and that, if we could keep this portal properly guarded, we might experience the same immunity from disease that the lower orders do, and all of us live out our appointed days. If we only knew just what to eat and how much, the doctor and the druggist would soon be bankrupt. Malnutrition is the source of most of our woe.

If each one of us were properly fed, so that our digestion and assimilation were as perfect as that of our brute neighbors, we should doubtless share their unbroken good health. We should resist all germ diseases — typhoid, smallpox, diphtheria, pneumonia, tuberculosis; the germ would find no soil in which it would thrive. Keep the blood pure and full, and we are self-armed against nearly all human ailments. If our stomachs were properly fed, there would be no appendicitis, or liver-complaint, or rheumatism, or kidney-trouble, or premature old age. Overwork might still claim its victims, and excessive grief destroy the overemotional, but there would be fewer of each. It is probable that even cancer would finally disappear from a race perfectly fed.

But we go on just as we did when we were babies, putting everything into our mouths, even tobacco and alcohol, tea and coffee. The animal is stimulated by its food, but we resort to all sorts of artificial stimulants. Of course, we can't live as the animals or the savages do. Dining with us is a fine art; but, if it were a perfect art, it would touch nature again, and we should feed as sanely as the birds and the squirrels do. We should not corrupt nature, but follow her.

In the case of the lower animals the taste, or the appetite, is apparently a safe guide. What the creature loves, that agrees with it, or *vice versa*. The wild

creatures avoid poisonous plants and poisonous fruits. Animals in domestication are sometimes poisoned by strange plants or fruits, because they have lost, through domestication, the self-directing wit of the wild creatures.

With man his appetite is not a safe guide any more than it is while he is still a baby.

III

Animal intelligence differs from human intelligence in being below the plane of consciousness. It is a manifestation of the intelligence that pervades the universe. Animals know not what they do; they act without forethought or self-knowledge. They are wise as nature is wise; they are reasonable as the trees and plants are reasonable.

The plants adapt means to an end as definitely as man does; they clothe themselves against the cold; they protect themselves against the heat; they develop hooks and springs and wings to scatter their seed; some of them perfect curious mechanical devices to secure cross-fertilization; they swim, they fly, they walk, they catch a ride, to disperse themselves over the earth; they develop bladders to float by, tendrils and suckers to climb with, gum and varnish against the rain; they use anchors, they employ traps, they store food; indeed, the vegetable kingdom holds the original patent for many of our de-

vices for getting on in the world. And what the vegetable does not hold, the animal does.

These devices all imply intelligence and foresight in adapting means to an end, but it differs from human intelligence as does that of the lower animals in not yet having come to a knowledge of itself. Their wisdom, their prudence, their reason, is that of the whole of nature. The acquired, the individual, the experimental wisdom of man is quite another thing. The plants profit by experience also, but they profit slowly, through race-discipline. Neither the plant nor the animal can set the environment at naught — turn winter into summer, wet into dry, the adverse into the favorable — as can man.

The animals do not know what they do any more than we know what we are doing when we do a thing from habit, or, as we say, in an absent frame of mind, or than the sleep-walker knows what he is doing. Indeed, animal behavior is, for the most part, a kind of sleep-walking, an unconscious performance of what are often difficult feats.

Yesterday I saw a cat stalking a chipmunk on the top of the stonework; while the chipmunk had his eye on her, she crouched low and kept perfectly still; then, as the chipmunk disappeared beneath the stones, the cat, after a little delay, rushed to the place, and looked quickly right and left and up and down to make sure not to miss him if he were still in view, or should suddenly emerge from his hiding.

The cat's action was precisely what yours or mine would have been under the same circumstances. Now, shall we say that she was thinking of her problem as you or I would have been? No, she has no conscious thought at all. Nature thought for her. She was the instrument of an intelligence not her own. She reasoned no more than the clouds reason when they drop rain, or than the roots of a tree reason when they go toward the water, or than the vine reasons when it reaches out its tendrils for support.

All such acts on the part of the animals of prey — stalking, circling, waiting, and the like — show the action of mind; but it is mind below the level of consciousness. The action of the cat was like yours or mine when we do not think what we are doing. It is this power of thought, which knows itself, and takes account of itself, that constitutes the gulf between man and his brute kindred.

IV. BIRD-NESTING TIME

The other day I sat for an hour watching a pair of wood thrushes engaged in building their nest near "Slabsides." I say a pair, though the female really did all the work. The male hung around and was evidently an interested spectator of the proceeding. The mother bird was very busy bringing and placing the material, consisting mainly of dry maple leaves which the winter had made thin and soft, and which were strewn over the ground all about. How pretty

she looked, running over the ground, now in shade, now in sunshine, searching for the leaves that were just to her fancy! Sometimes she would seize two or more and with a quick, soft flight bear them to the fork of the little maple sapling. Every five or six minutes during her absence, the male would come and inspect her work. He would look it over, arrange a leaf or two with his beak, and then go his way. Twice he sat down in the nest and worked his feet and pressed it with his breast, as if shaping it. When the female found him there on her return, he quickly got out of her way.

But he brought no material, he did no needful thing, he was a bird of leisure. The female did all the drudgery, and with what an air of grace and ease she did it! So soft of wing, so trim of form, so pretty of pose, and so gentle in every movement! It was evidently no drudgery to her; the material was handy, and the task one of love. All the behavior of the wood thrush affects one like music; it is melody to the eye as the song is to the ear; it is visible harmony. This bird cannot do an ungraceful thing. It has the bearing of a bird of fine breeding. Its cousin the robin is much more masculine and plebeian, harsher in voice, and ruder in manners. The wood thrush is urban and suggests sylvan halls and courtly companions. Softness, gentleness, composure, characterize every movement. In only a few instances among our birds does the male assist in nest-building.

He is usually only a gratuitous superintendent of the work. The male oriole visits the half-finished structure of his mate, looks it over, tugs at the strings now and then as if to try them, and, I suppose, has his own opinion about the work, but I have never seen him actually lend a hand and bring a string or a hair. If I belonged to our sentimental school of nature writers I might say that he is too proud, that it is against the traditions of his race and family; but probably the truth is that he does n't know how; that the nest-building instinct is less active in him than in his mate; that he is not impelled by the same necessity. It is easy to be seen how important it is that the nesting instinct should be strong in the female, whether it is or not in the male. The male may be cut off and yet the nest be built and the family reared. Among the rodents I fancy the nest is always built by the female.

Whatever the explanation, the mother bird is really the head of the family; she is the most active in nest-building, and in most cases in the care of the young; and among birds of prey, as among insects, the female is the larger and the more powerful.

The wood thrush whose nest-building I have just described, laid only one egg, and an abnormal-looking egg at that — very long and both ends of the same size. But to my surprise out of the abnormal-looking egg came in due time a normal-looking chick which grew to birdhood without any mishaps. The

late, cold season and the consequent scarcity of food was undoubtedly the cause of so small a family.

Another pair of wood thrushes built a nest on the low branch of a maple by the roadside, where I had it under daily observation. This nest presently held three eggs, two of which hatched in due time, and for a few days the young seemed to prosper. Then one morning, I noticed the mother bird sitting in a silent, meditative way on the edge of the nest. As she made no move during the minute or two while I watched her, I drew near to see what was the matter. I found one of the young birds in a state of utter collapse; it was cold and all but lifeless. The next morning I found the bird again sitting motionless on the rim of the nest and gazing into it. I found one of the birds dead and the other nearly so. What had brought about the disaster I could not tell; no cause was apparent. I at first suspected vermin, but could detect none. The silent, baffled look of the mother bird I shall not soon forget. There was no demonstration of grief or alarm; only a brooding, puzzled look.

I once witnessed similar behavior on the part of a pair of bluebirds that were rearing a brood in a box on a grape post near my study. One day I chanced to observe one of the parent birds at the entrance of the nest, gazing long and intently in. In the course of the day I saw this act several times, and in no case did the bird enter the box with food as it had been

doing. Then I investigated and found the nearly fledged birds all dead. On removing them I found the nest infested with many dark, tough-skinned, very active worms or grubs nearly an inch long, that had apparently sucked the blood out of the bodies of the fledglings. They were probably the larvæ of some species of beetle unknown to me. The parent birds had looked on and seen their young destroyed, and made no effort to free the nest of their enemy. Or probably they had not suspected what was going on, or did not understand it if they beheld it. Their instincts were not on the alert for an enemy so subtle, and one springing up in the nest itself. Any visible danger from without alarmed them instantly, but here was a new foe that doubtless they had never before had to cope with.

The oriole in her nest-building seems more fickle than most other birds. I have known orioles several times to begin a nest and then leave it and go elsewhere. Last year one started a nest in an oak near my study, then after a few days of hesitating labor left it and selected the traditional site of her race, the pendent branch of an elm by the roadside. This time she behaved like a wise bird and came back for some of the material of the abandoned nest. She had attached a single piece of twine to the oak branch, and this she could not leave behind; twine was too useful and too hard to get. So I saw her tugging at this string till she loosened it, then

flew toward the elm with it trailing in the air behind her. I could but smile at her thrift. The second nest she completed and occupied and doubtless found her pendent-nest instinct fully satisfied by the high swaying elm branch.

One of our prettiest nest-builders is the junco or snowbird; in fact, it builds the prettiest nest to be found upon the ground, I think — more massive and finely moulded and finished than that of the song sparrow. I find it only in the Catskills, or on their borders, often in a mossy bank by the roadside, in the woods, or on their threshold. With what delicate and consummate art it is insinuated into the wild scene, like some shy thing that grew there, visible, yet hidden by its perfect fitness and harmony with its surroundings. The mother bird darts out but a few yards from you as you drive or walk along, but your eye is baffled for some moments before you have her secret. Such a keen, feather-edged, not to say spiteful little body, with the emphasis of those two pairs of white quills in her tail given to every movement, and yet, a less crabbed, less hasty nest, softer and more suggestive of shy sylvan ways, than is hers, would be hard to find.

One day I was walking along the grassy borders of a beech and maple wood with a friend when, as we came to a little low mound of moss and grass, scarcely a foot high, I said, "This is just the spot

for a junco's nest," and as I stooped down to examine it, out flew the bird. I had divined better than I knew. What a pretty secret that little footstool of moss and grass-covered earth held! How exquisite the nest, how exquisite the place, how choice and harmonious the whole scene! How could these eggs long escape the prowling foxes, skunks, coons, the sharp-eyed crows, the searching mice and squirrels? They did not escape; in a day or two they were gone.

Another junco's nest beside a Catskill trout stream sticks in my memory. It was in an open grassy place amid the trees and bushes near the highway. There were ladies in our trouting party and I called them to come and see the treasure I had found.

"Where is it?" one of them said, as she stopped and looked around a few paces from me.

"It is within six feet of you," I replied. She looked about, incredulous, as it seemed an unlikely place for a nest of any sort, so open was it, and so easily swept by the first glance.

As she stepped along, perplexed, I said, "Now it is within one yard of you." She thought I was joking; but stooping down, determined not to be baffled, she espied it sheltered by a thin, mossy stone that stood up seven or eight inches above the turf, tilted at an angle of about that of one side of a house-roof. Under this the nest was tucked, sheltered from the sun and rain, and hidden from all but the sharpest eye.

V. WEASEL AND RABBIT

How the weasel catches the rabbit seems to be a mooted question. That he does catch him, every hunter and woodsman knows, but how, since the rabbit is much fleeter of foot? Some persons think the weasel stalks the rabbit, or mines down under him in the snow and thus seizes him in his form, or outwits him by some other strategy.

My own observations, as well as those of many others, lead me to believe that the weasel inspires the rabbit with such terror that the poor beast is in a measure paralyzed and falls an easy victim.

One morning after a light fall of snow, during my walk through the fields and woods I saw a rabbit-track and a mink-track together. I followed the trail to see what had happened. I had not gone far when I discovered tufts of rabbit-fur upon the snow; a few yards farther and there were drops of blood, the rabbit's leaps growing shorter and shorter, and in a few moments I came upon the half-devoured body of the rabbit lying in the open. That the mink had run the rabbit down and caught him was as plain as the snow record could be. There was no hiding under the snow by the mink and not the least evidence that the rabbit had been surprised. Rabbits see behind them quite as readily as before, and I doubt if any animal could steal upon a moving rabbit at night and not be seen.

The rabbit is a nocturnal animal. It does not sit in its form at night to be stalked by its enemies, or to be taken by any sapping and mining process. In daylight a weasel might steal upon it and seize it in its form, but not by night. In my part of the country, the rabbit runs to hole in the winter and passes the day there. The boys catch it with ferrets. The minks and weasels catch it in its hole alone. My hired man, who is an old hunter, tells me he once saw upon the snow where a mink had brought a rabbit out of a hole and carried it a long distance to his den. He followed the trail and saw by the imprint upon the snow that every little while the mink had had to lay down his burden and rest.

Five men live near me who spend much of their time in winter hunting and trapping. They are keen observers and perfectly reliable; what they tell me they have seen I accept as freely as if I had seen it myself. I might not always accept their inferences from, or other interpretations of, what they had seen, but the fact itself I never question.

One of these men told me that one autumn day after the first snow-fall, in his walk he came upon a rabbit-track followed by that of a weasel. He took up the trail and presently in a clear, open place in the woods he came upon the dead rabbit still in the clutches of the weasel. The rabbit was warm and limp. The marks upon the snow showed that the weasel had caught the rabbit in the open when the

latter was still running, but running in a feeble, hesitating manner.

Another trapper told me a similar story. He saw upon the snow where a mink had run a rabbit round a small hill. They had made the circuit several times, the rabbit's leaps growing shorter and shorter, until at last the mink had seized it and drunk its blood and eaten a hole in its neck. I can account for such things upon no other theory than that the rabbit, when it finds itself followed by its deadly enemy, gradually becomes paralyzed with fear and falls an easy victim. No doubt the lynx and the wildcat and the fox waylay the rabbit at night as a cat does a mouse or a squirrel, but the weasel tribe follow it and are as relentless as fate itself. A rat pursued by a weasel is fairly beside itself with fear, and has been known to take refuge in a bed where a man was sleeping, in order to escape. A chicken or a hen pursued by a weasel is in a perfect panic of fright, and I have seen the pursuing weasel follow the fleeing and screaming fowl to my very feet, when he seized it and was pinned to earth by my boot. I saw him catch the full-grown chicken; why could he not catch a rabbit? When I seized him with my thumb and finger back of the ears and held him so he could not bite me, did ever anything look so fierce and devilish as this creature did? His eyes fairly burned. It seemed as if I could see the blood of his victims aflame in them. I dashed him fiercely upon

the ground and set my fox-terrier upon him, but the weasel got in the first bite every time and would have escaped had I not again set my foot upon him. I think the weasel quite capable of *sneaking* upon his prey, but in all the cases that have come under my observation, from chipmunks to domestic fowls, he seizes his victim when it is in flight.

I have known a weasel to drive a chipmunk to the topmost branch of a tall tree, and when he was about to seize it, the chipmunk let go its hold and fell with a cry of despair. In its descent it caught by chance on a limb to which it clung, a picture of abject terror, till the weasel gave up the search and left the tree, when the chipmunk, after a long waiting, timidly crept down to the earth.

More light is thrown upon this question by letters I have recently received from two correspondents, one from Kansas and one from Alaska. The incidents given agree so well with my own observations that I have no doubt about their truth. The Skagway correspondent writes: "The manners in which the slim and aggressive weasel catches the rabbit may be many, but on two occasions I saw the deed done. The first time I was driving across a field of wheat stubble in the west of England, and, hearing the scream of a rabbit, I looked about for the cause, and saw a weasel chasing one with leaps and bounds somewhat like the movements of a snake, but more rapid. The rabbit finally stopped, apparently from

fear, and the weasel caught it and had killed it before I got near them. When I reached them, I jumped out and picked up the rabbit with the weasel still holding fast, but I finally shook it off and it hid itself in a thorn hedge near by. Having no use for the rabbit, I dropped it on the ground and drove on a bit, when I stopped and looked back, curious to see what would happen. The weasel, feeling safe and no doubt hungry, returned to its kill and dragged it into the long grasses and plants of the hedgerow.

"Another time, while musing and anon casting a fly over the placid waters of a favorite trout stream in the same locality, I was startled by a rabbit jumping into the pool and swimming to the other side, followed in a moment or so by a weasel, who also took to the water, being so close that he evidently saw the rabbit. They both disappeared in the vegetation beyond, but hearing the rabbit's plaintive cry shortly after, was evidence to me that another tragedy had been enacted."

My Kansas correspondent, a lawyer, tells me of an incident related to him by an old Pennsylvania friend, a man of prominence and absolutely reliable. This time the weasel was pursuing a rat. While standing in a large cellar under a stonework, he heard a rat scream with the most evident fear and distress. "Looking in the direction of the noise, he saw a very large store rat running rapidly along the cellar floor and up the stairway; the rat went to the outer edge,

so as to look back over the track it had come, and there crouched down, shivering with apparent fear. Mr. Kerr was at first at a loss to know what had disturbed the rat, but in a little while noticed a weasel coming along the cellar floor and on the track of the rat. The weasel came much more slowly than the rat had come, as it had to follow the trail entirely by scent. Mr. Kerr was standing near the rat all this time and watching it. As the weasel drew near the stairway, the rat began to scream again. By this time the weasel saw Mr. Kerr. It stopped for a moment and eyed him intently, and then, as if in contempt of him, passed on and rushed upon the rat with a ferocity and indifference almost incredible for so small an animal. The rat simply cowered and screamed and made no resistance whatever. The weasel seized the rat around the neck with its fore paws and fastened its teeth in the rat's throat in a mere instant of time, and the struggle was over before it could be said to have fairly begun.

"That an animal so combative as the rat, and especially one so large as the one in the present instance (for it was, if anything, heavier than the weasel) should yield without a struggle, Mr. Kerr says, filled him with astonishment, as did also the fact that the rat, though having a free field and abundance of time to fly out of the cellar, or to seek refuge elsewhere in the many holes in the walls of the cellar, failed to do so. He says he scarcely could

have credited the transaction had it been related to him by others and not seen by himself, and he regards it as one of the strangest, and most unexpected experiences of his life, and he has been a man of much experience and affairs."

Very recently in my own neighborhood, two hunters well known to me were in the woods when they saw what they at first took to be two red squirrels chasing each other round the bole of a tree. On coming nearer, they saw that there was but one red squirrel, and that it was being hotly chased by a weasel. The squirrel was nearly tired out and must soon have fallen a victim to its arch enemy had not the hunters shot the weasel. Why the squirrel did not lead off through the tree-tops, where the weasel could not have followed him, is another instance of the mystery that envelops this question.

The story of my Alaskan correspondent indicates that in Great Britain as well as in this country the weasel tribe has the same mysterious power over the rabbit. Additional evidence of this is given by an English correspondent who writes me: "I once saw a stoat chasing a hare on a country road. The hare was going very slowly and haltingly; the stoat was close upon it, and soon would have caught it had I not driven it away from the hare. My father, who was with me, told me then of the paralyzing effect the sight of a stoat had upon a hare, as did three or four other men to whom I related the incident." This

correspondent concludes his letter with an extract from a paper in the London "Graphic" for December 4, 1909, called "The Hypnotized Hare": "The most piteous of all the voices of the night is the cry of the hare in the clutches of a stoat. Now this tragedy, which is fairly common, has an element of mystery about it which has never been solved. A hare, of course, in the ordinary course of things could easily outstrip a stoat, and yet when a hare knows that the deadly foe is on its track, instead of putting forth all its swiftness, it labors along with the heavy gait with which one tries to escape from an enemy in a nightmare. The movements . . . suggest that the stoat has some occult power of hypnotizing its quarry and paralyzing its power of flight."

VI. WILD LIFE IN WINTER

To many forms of life of our northern lands, winter means a long sleep; to others it means what it means to many fortunate human beings — travels in warm climes; to still others, who again have their human prototypes, it means a struggle, more or less fierce, to keep soul and body together; while to many insect forms it means death.

Most of the flies and beetles, wasps and hornets, moths, butterflies, and bumblebees die. The grasshoppers all die, with eggs for next season's crop deposited in the ground. Some of the butterflies winter over. The mourning cloak, the first butter-

fly to be seen in spring, has passed the winter in my "Slabsides." The monarch migrates, probably the only one of our butterflies that does. It is a great flyer. I have seen it in the fall sailing serenely along over the inferno of New York streets. It has crossed the ocean and is spreading over the world. The yellow and black hornets lose heart as autumn comes on, desert their paper nests and die — all but the queen or mother hornet; she hunts out a retreat in the ground and passes the winter beyond the reach of frost. In the spring she comes forth and begins life anew, starting a little cone-shaped paper nest, building a few paper cells, laying an egg in each, and thus starting the new colony.

The same is true of the bumblebees; they are the creatures of a summer. In August, when the flowers fail, the colony breaks up, they desert the nest and pick up a precarious subsistence on asters and thistles till the frosts of October cut them off. You may often see, in late September or early October, these tramp bees passing the night or a cold rainstorm on the lee side of a thistle-head. The queen bee alone survives. You never see her playing the vagabond in the fall. At least I never have. She hunts out a retreat in the ground and passes the winter there, doubtless in a torpid state, as she stores no food against the inclement season. Emerson has put this fact into his poem on "The Humble-Bee": —

> "When the fierce northwestern blast
> Cools sea and land so far and fast,
> Thou already slumberest deep;
> Woe and want thou canst outsleep;
> Want and woe, which torture us,
> Thy sleep makes ridiculous."

In early August of the past year I saw a queen bumblebee quickly enter a small hole on the edge of the road where there was no nest. It was probably her winter quarters.

If one could take the cover off the ground in the fields and woods in winter, or have some magic ointment put upon his eyes that would enable him to see through opaque substances, how many curious and interesting forms of life he would behold in the ground beneath his feet as he took his winter walk—life with the fires banked, so to speak, and just keeping till spring. He would see the field crickets in their galleries in the ground in a dormant state, all their machinery of life brought to a standstill by the cold. He would see the ants in their hills and in their tunnels in decaying trees and logs, as inert as the soil or the wood they inhabit. I have chopped many a handful of the big black ants out of a log upon my woodpile in winter, stiff, but not dead, with the frost, and brought them in by the fire to see their vital forces set going again by the heat. I have brought in the grubs of borers and the big fat grubs of beetles, turned out of their winter beds in old logs by my axe and frozen like ice-cream, and

have seen the spark of life rekindle in them on the hearth.

With this added visual power, one would see the wood frogs and the hylas in their winter beds but a few inches beneath the moss and leaf-mould, one here and one there, cold, inert, biding their time. I dug a wood frog out one December and found him not frozen, though the soil around him was full of frost; he was alive but not frisky. A friend of mine once found one in the woods sitting upon the snow one day in early winter. She carried him home with her, and he burrowed in the soil of her flower-pot and came out all right in the spring. What brought him out upon the snow in December one would like to know.

One would see the tree-frogs in the cavities of old trees, wrapped in their winter sleep — which is yet not a sleep, but suspended animation. When the day is warm, or the January thaw comes, I fancy the little frog feels it and stirs in his bed. One would see the warty toads squatted in the soil two or three feet below the surface, in the same way. Probably not till April will the spell which the winter has put upon them be broken. I have seen a toad go into the ground in late fall. He literally elbows his way into it, going down backwards.

Beneath rocks or in cavities at the end of some small hole in the ground, one would see a ball or tangle of garter snakes, or black snakes, or copper-

heads — dozens of individual snakes of that locality entwined in one many-headed mass, conserving in this united way their animal heat against the cold of winter. One spring my neighbor in the woods discovered such a winter retreat of the copperheads, and, visiting the place many times during the warm April days, he killed about forty snakes, and since that slaughter, the copperheads have been at a premium in our neighborhood.

Here and there, near the fences and along the borders of the wood, these X-ray eyes would see the chipmunk at the end of his deep burrow with his store of nuts or grains, sleeping fitfully but not dormant. The frost does not reach him and his stores are at hand. One which we dug out in late October had nearly four quarts of weed-seeds and cherry-pits. He will hardly be out before March, and then, like his big brother rodent the woodchuck, and other winter sleepers, his fancy will quickly "turn to thoughts of love."

One would see the woodchuck asleep in his burrow, snugly rolled up and living on his own fat. All the hibernating animals that keep up respiration, must have sustenance of some sort — either a store of food at hand or a store of fat in their own bodies. The woodchuck, the bear, the coon, the skunk, the 'possum, lay up a store of fuel in their own bodies, and they come out in the spring lean and hungry. The squirrels are lean the year through, and hence

must have a store of food in their dens, as does the chipmunk, or else be more or less active in their search all winter, as is the case with the red and gray squirrels. The fox puts on more or less fat in the fall, because he will need it before spring. His food-supply is very precarious; he may go many days without a morsel. I have known him to be so hungry that he would eat frozen apples and corn which he could not digest. The hare and the rabbit, on the other hand, do not store up fat against a time of need; their food-supply of bark and twigs is constant, no matter how deep the snows. The birds of prey that pass the winter in the north take on a coat of fat in the fall, because their food-supply is so uncertain; the coat of fat is also a protection against the cold.

Of course, all the wild creatures are in better condition in the fall than in the spring, but in many cases the fat is distinctly a substitute for food.

The skunk is in his den also from December till February, living on his own fat. Several of them often occupy the same den and conserve their animal heat in that way. The coon, also, is in his den in the rocks for a part of the winter, keeping warm on home-made fuel. The same is true of the bear in our climate. The bats are hibernating in the rocks or about buildings. The muskrats are leading hidden lives in the upper chambers of their snow-covered

houses in the marshes and ponds or in the banks of streams, feeding on lily-roots and mussels which they get under the ice.

The lean, bloodthirsty minks and weasels are on the hunt all winter. Our native mice are also active. That pretty stitching upon the coverlet of the winter snow in the woods is made by our white-footed mouse and by the little shrew mouse. The former often has large stores of nuts hidden in some cavity in a tree; what supply of food the latter has, if any, I do not know. In the winter the short-tailed meadow or field mice come out of their retreat in the ground and beneath stones and lead gay, fearless lives beneath the snow-drifts. Their little villages, with their runways and abandoned nests, may be seen when the snow disappears in the spring. Their winter life beneath the snow, where no wicked eye or murderous claw can reach them, is in sharp contrast to their life in summer, when cats and hawks, owls and foxes, pounce upon them day and night. It is only in times of deep snows that they bark our fruit-trees.

We have in this latitude but one species of hibernating mouse — the long-tailed jumping mouse, or kangaroo mouse, as it is sometimes called from its mode of locomotion. Late one fall, while making a road near "Slabsides," we dug one out from its hibernation about two feet below the surface of the ground. It was like a little ball of fur tied with a

string. In my hand it seemed as cold as if dead. Close scrutiny showed that it breathed at intervals, very slowly. The embers of life were there, but slumbering beneath the ashes. I put it in my pocket and went about my work. After a little time, remembering my mouse, I put my hand into my pocket and touched something very warm and lively. The ember had been fanned into a flame, so to speak. I kept my captive in a cage a day or two and then returned it to the woods, where I trust it found a safe retreat against the cold.

VII. A FEATHERED BANDIT

One day as I sat at my desk I caught a glimpse of swiftly moving wings about the trunk of a large maple that stands in front of my window. A second glance showed me a shrike, or butcher-bird, pursuing some small bird round the tree. Rushing to the door, I saw that the pursued was a brown creeper and that the little bird was taxing its wit and its wings to the utmost to avoid being seized by the shrike. Its obvious tactics were to keep the trunk of the tree between it and its enemy. As the creeper spends most of its time on the trunks of trees seeking its minute food, it is entirely at home there. Its protective coloration, as it is called, is supposed to be of great service in concealing it from its enemies, but it seemed to avail it little in the present case.

When the shrike lost sight of it for a moment as

it darted round the tree-trunk, he began exploring the tree all the way to the top. Then he dropped down to near the bottom, and in so doing started the creeper from its place of hiding. It came quickly on my side of the tree and stopped, clinging to the bark where it was partly shielded and hidden by a rope attached to a hammock. There it crouched motionless and, I fancied, trembling for its life. The shrike has not the talons of the bird of prey and hence it cannot strike its quarry as the hawk can. Its weapon is its slightly hooked beak. With this it breaks the skulls of its victims and then sups upon their brains. The little creeper acted as if it knew all this, but I suppose all it knew was that a large bird with a murderous instinct was hotly pursuing it.

The shrike in his search now alighted upon the hammock; this act caused the rope to move that partly concealed the creeper, and away it flew, no doubt in a panic of fear. The shrike saw it and gave chase, but before I could get into the open where I could see the issue, both birds had disappeared, nor could I see a feather of either anywhere on the ground or among the trees of the neighborhood. I think the creeper escaped, though I thought its leaving the maple was very bad tactics.

In December, 1910, my son and I witnessed a little bird tragedy which showed how fatal it is for one of our smaller birds to seek to escape from the murderous shrike by open flight. I had just stepped out

of my study door and was gazing out upon the white landscape, when my son, who was passing by a woven-wire fence, about fifty yards away, with a piece of timber upon his shoulder, called out to me, "See those birds." Two birds, one in hot pursuit of the other, had struck the woven-wire fence at his elbow, had struggled through the meshes, and gone racing through the vineyard in my direction. I saw them coming down between two rows of grapevines in desperate flight. I saw at a glance that it was a shrike pursuing a junco or snowbird, and that the assassin was gaining on his victim. As they got opposite me and about forty yards below me, the junco, finding its enemy dangerously near, turned its course sharply to the right, crossing the line of wires supporting the vines.

Then just what happened, or rather just how the deed was done, my eye was not quick enough to see, but the shrike struck his victim down, probably with his beak, and fell with it to the ground. I rushed to the rescue as fast as possible, but before I could reach the spot, the shrike had killed his victim, carried it to the top of a grapevine, tightened his hold, and was off down the hill toward a line of trees, with its limp form hanging beneath him. There was the imprint in the snow where the birds had fallen, but not a feather or a drop of blood to tell of the tragedy that had been enacted there.

Later in the winter, while trimming the grape-

vines, I heard a bird scream, and, looking in the direction, saw that a robin was being hotly pursued by a shrike. The robin was darting in and about a spruce-tree, screaming his protest and leaving a trail of feathers behind where the shrike struck him. Presently, still shouting his protests, he left the shelter of the spruces and disappeared over the hill, closely pursued by the shrike. What the final issue was no one knows. I had not supposed that the shrike ever attacked so large a bird as the robin. He certainly could not carry away a bird of more than his own weight, though he might kill it by a blow upon its head, as he probably did in this case.

The wild life about us is full of tragedies, both winter and summer. Many of the records upon the snow tell a story of only fear or pain.

THE END

INDEX

Animals, mind of, 113–136; amputating their own legs, 115–117; lack of perception of the humorous, 118–120; the play of, 120; creatures of habit, 123, 124; can be trained but cannot be educated, 124, 133; use of signals by, 129; their tools a part of themselves, 130, 131; activities determined by their organization, 138, 139; nature of their intelligence, 139, 140; wise in their own sphere and stupid out of it, 141; strength of their instincts, 142; food habits, 143, 144; adaptiveness, 146; automatic actions of, 146–154; instinct, not habit, the key to their behavior, 155–174; habit in domestic, 162; instinct in domestic, 164; laboratory experiments on psychology of, 165–168, 175–200; memory in, 169; tropisms in, 169, 170; lack of self-consciousness, 193; community of mind in, 197–199; untaught wisdom of, 201–211; influence of domestication upon, 201; training of, 208; feeding instincts, 262–265; their intelligence below the level of consciousness, 265–267.
Ants, 203, 204, 283.
Apes, gleams of reason in, 202.

Barn, a study in a, 24, 93, 94, 223.
Bats, 286.
Bears, getting rid of traps, 117.
Beaver, amputating its own leg, 115, 116.
Bee. *See* Honey-bee.
Bees, solitary, 205.
Beetle, sacred, 205.
Bergson, Henri, his "Creative Evolution," 71–73, 91 *note*.
Birds, relation of books to, 12; study and love of, 12, 13; as a piece of living nature, 13; interest in, 36; morning awakening, 43; second and third nests, 149; reasons for seeking vicinity of man, 149–151; color and color-sense, 194–196; musical sense, 196, 197; possible telepathy, 197, 198; the mother the main bread-winner, 226; dangers to ground nests, 232; automatic character of bird-song, 256–261; origin of bird-song, 257; defective voices, 261; the male in nest-building, 268, 269; the mother the head of the family, 269.
Blood, circulation of, 237.
Bluebird (*Sialia sialis*), behavior of a pair whose nest had been removed, 120–123; feeding young, 226; young killed by grubs, 270, 271.
Bobolink (*Dolichonyx oryzivorus*), 193; song of, 258; a bird with a defective voice, 261.
Bob-white. *See* Quail.
Body, the, structure of, 18–21.
Books, 5, 6.
Bumblebee, 83; an unfortunate, 234; wintering, 282, 283.
Burroughs, John, looking back upon his life, 1–14; in love with this world, 2; secluded life, 2, 3; never a fighter, 4; things missed, 4–7; education, 5; literary career, 5; relation to books, 5, 6; and the soldier's life, 7–10; and nature, 10–14; and the other world, 14, 15; satisfied with this world, 14, 15; the lesson of his life, 23.
Butcher-bird. *See* Shrike.
Butterflies, in winter, 281, 282.
Butterfly, monarch, 282.
Butterfly, mourning-cloak, 281.

Candelabra-tree, 203, 204.
Carlyle, Thomas, and evolution, 57, 58.
Cat, stalking a chipmunk, 266, 267.

INDEX

Catskills, the, the author's farm in, 24–47; age of, 37–39.
Cause, first, 222.
Cells, 18–21, 92.
Chickadee (*Penthestes atricapillus*), 249.
Children, 6, 7.
Chimpanzee, 114, 115.
Chipmunk, 106, 114, 153, 254; winter stores, 46, 47, 243, 244, 285; watchfulness, 9, 4, 95; catching a flying grasshopper, 110; a timid, 111; method of excavating winter quarters, 238–242, 245, 246; leaving no trail, 239, 240; dug out of its hole, 243; 245; wintering, 245, 285; and weasel, 277.
Civilization, and science, 66–68.
Clifford, W. K., 50.
Cock, 193.
Color, and color-blindness, 194–196.
Coon. *See* Raccoon.
Copperhead, 285.
Cows, in the pastoral landscape, 31–33; landscape gardeners, 128, 129.
Crab, hermit, 202, 203.
"Creative Evolution," by Henri Bergson, 71–73, 91 *note*.
Creeper, brown (*Certhia familiaris americana*), and shrike, 288, 289.
Crossbill (*Loxia* sp.), eating peach blossoms, 161.
Crow, American (*Corvus brachyrhynchos*), a true countryman, 39; in early morning, 40; mass meetings, 40, 41; sociability, 41, 42; bearing, 42; talkativeness, 43; training a marsh hawk, 102, 103; business, 103, 104; character, 104; adaptiveness in regard to food, 146; feeding young, 253; way of carrying things, 256.

Dandelion, seed and the birds, 254.
Darwin, Charles, his imagination, 63; and the religious attitude of mind, 69; an observation of his, 146; his sexual selection theory, 194–197.
Dogs, dog and woodchuck, 29; responsiveness, 131, 132; blood-relationship to man, 132; intellectuality, 132, 133; psychological experiments on, 191, 192; influence of domestication upon, 201; learning from man, 207, 208; a singing dog, 208; a dog eating a mushroom, 211.
Ducks, young, and water, 164, 165.

Eliot, George, quoted, 25.
Elm, seeds and squirrels, 254, 255.
Emerson, Ralph Waldo, quoted, 25, 33, 127, 256, 282, 283; and science, 70, 71.
Evolution, the paths of, 17; extrinsic conditions and intrinsic necessity in, 87–92; its wayward, blundering course, 91.

Farmer, the, 34–36.
Farms, East and West, 36–39.
Finch, purple (*Carpodacus purpureus*), 254.
Fiske, John, quoted, 173.
Flicker. *See* Highhole.
Fox, eating corn, 161; power of sight, 192; in winter, 286.
Frog, wood, 284.
Frogs, hearing of, 199.

Goethe, quoted, 61.
Goldenrod, 236.
Goldfinch, American (*Astragalinus tristis*), 254.
"Graphic," the London, quoted, 281.
Grasshoppers, 281.

Habit, not the key to animal behavior, 156–174; formation of, 167.
Haeckel, Ernest, 50.
Hare, 286.
Hare, European, chased by stoat, 280, 281.
Hare, little chief, haymaking, 144.
Hawk, marsh (*Circus hudsonius*), hunting, 102; and crows, 102, 103.
Hawk, sharp-shinned (*Accipiter velox*), 97, 103.

INDEX

Hawk, sparrow (*Falco sparverius*), releasing itself, 79.
Hawks, silent and solitary, 104; feeding habits and scarcity, 146; mode of carrying prey, 256.
Hibernation, 281–288.
Highhole, or northern flicker (*Colaptes auratus luteus*), 97.
Hills, the peace of the, 25, 26.
Honey-bee, Nature's random method illustrated by, 81–84; limits of her knowledge, 153, 154; the drone fatherless, 237, 238.
Hornaday, William T., 114, 115, 144.
Hornets, nests of, 151, 152; wintering, 282.
Hospital, a military, 9.
Humorous, perception of the, 118–120.
Huxley, Thomas Henry, 50, 54, 57, 237; quoted, 59, 88; a scientific idealist, 69.

Ice-sheet, continental, 79, 80.
Ichneumon-fly, 203.
Indigo-bird (*Passerina cyanea*), song of, 257; manner of singing, 259–261.
Insects, making use of nature, 128; intelligence of, 203, 205, 206; music of, 261, 262; in winter, 281–283.
Instinct, price paid for, 136; inherent unconscious intelligence constantly in operation, 140; heaping measures of, 142; the killing instinct, 152, 153; the key to animal behavior, 155–174; instinct and instincts, 162; maternal instinct, 162, 163; homing instinct, 162–164; not found in the lower forms, 169, 170; physics of, 172; times of development of instincts, 172, 173; as untaught wisdom, 201–211; and the power of choice, 209–211.

James, William, quoted, 187.
Jay, blue (*Cyanocitta cristata*), habitat, 42, 43; teasing a sharp-shinned hawk, 103.
Jordan, David Starr, and Vernon Kellogg, their "Evolution and Animal Life," 209, 210.
Junco, or snowbird (*Junco hyemalis*), with a nest in a haymow, 99–102; a fidgety bird, 100; story of another haymow nest, 231–233; nervousness, 232, 233; beauty of the nest, 272; two nests, 272, 273; caught by a shrike, 289, 290.

Katydid, 262.
Kingbird (*Tyrannus tyrannus*), 150.
Kingfisher, a Cape Verde Islands, 146.
Knowledge, through sympathy, 12.

Laboratory experimentation on animals, *vs.* observation, 165–168, 175–200; takes them out of the animal sphere, 179–183; narrowness of the field, 183–185; domestic animals generally used, 191.
Lankester, Ray, 133; quoted, 134, 135.
Laughter, 118, 119.
Leaves, falling, 246–248.
Life, the physico-chemical explanation of, 55, 56; scientific view of, 58; begets life, 91, 29.
Literature, its gain in this economic age, 74, 75.
Loeb, Jacques, his experiments, 168–170.
Lowell, James Russell, quoted, 258.
Lubbock, Sir John, 17, 205.

McClure's Magazine, 156 *note*.
Maeterlinck, Maurice, 20.
Man, animal origin of, 56–58; cannot live by science alone, 60; Nature's supremacy over, 85, 86; evolution of, 87–90; made up of a multitude of cells, 92; as master of Nature, 128; hints of his faculties in the lower animals, 129; origin of his reason, 133–136; the fall of, 135; the price of his privileges, 136, 137; many of his acts determined by causes outside of his own will, 141; his intelligence

plays inside the cosmic intelligence, 145; and his instincts, 158–161; his organization not specialized, 159, 160, 204; his superiority to the higher mammals, 178, 179; has to learn what to eat, 262–265.
Mayer, A. G., 195.
Mechanism *vs.* vitalism, 55, 56.
Memory, in animals, 169.
Mice, wood, 113.
Mind, the animal, 113–136; in nature, 124–128, 145, 206, 207.
Mink, killing rabbits, 274–276.
Monkeys, using tools, 114, 115, 129, 130; perception of the humorous, 120; monkey and puzzle-box, 176; color-sense, 196; instinct in eating eggs, 210, 211.
Moth, promethea, 195.
Mountains, age of, 37, 38.
Mouse, jumping, or kangaroo mouse, 287, 288.
Mouse, meadow, 287.
Mouse, shrew, 287.
Mouse, white-footed, 153, 287.
Murres, in Bering Sea, 164.
Muskrat, 286.

Nature, the book of, 13, 14; hit-and-miss method of, 76–92; blind, groping intelligence of, 77; superiority over man, 85, 86; the balancing of her books, 86; has no need of eyes, 88; mind in, 124–128; "trial and error" methods of, 125, 126; relation to the animals and to man, 128, 129; her thinking, 139–154.
Nervous system, 169.
Night, 22, 23.
Nuts, the natural planting of, 85.

Observation, *vs.* laboratory experimentation, 165–168, 175–200; intensive, 236.
Oriole, Baltimore (*Icterus galbula*), nests of, 147, 148, 150; nest-building, 269, 271, 272.

Phœbe (*Sayornis phœbe*), 150; nesting, 97, 98; fly-catching, 98, 99, 228; plural nests, 141, 142; and a pair of barn swallows, 223; secrecy about nest, 225; young in nest, 225; homeliness, 225; young leaving nest, 231; repeating call, 259.
Phonograph, the, 171.
Pika, haymaking, 144.
Planetary systems, evolution of, 81.
Plants, and seed-ripening, 149, 207; intelligence of, 181, 203, 204, 266; adapting means to an end, 265.
Play, in animals, 120.
Poetry, and science, 61–63.
Prairie, the, 36, 37.

Quail, or bob-white (*Colinus virginianus*), 146.

Rabbit, a timid, 96; and weasel, 274–281; can see behind, 274; nocturnal, 275; in winter, 286.
Raccoon, 167, 168, 196, 211, 286.
Rainbow, the, 212–216.
Rat, stealing green peas, 96; and weasel, 278, 279.
Raven, northern (*Corvus corax principalis*), 43.
Reason, origin of, 133–136; price paid for, 136; and the power of choice, 209–211.
Reid, G. Archibald, his book "The Laws of Heredity" quoted, 187.
Robin (*Planesticus migratorius*), 143, 150, 268; plural nests, 141, 142; variation in number of eggs, 148; an odd nesting-site, 180; attacked by a shrike, 290, 291.
Roosevelt, Theodore, 164.
Roosters, 193.

Science, and the spiritual, 48–55; limitations, 54, 55; occupied with the physical side of things, 58–62; no mystery to, 61; and poetry, 61–63; our debts to, 64–66; and the evils of our civilization, 66–68; and some modern poets, 70, 71; in Bergson's "Creative Evolution," 71–73; its influence on modern life, 73–75.
Sea-anemone, 202, 203.

Seed, Nature's prodigality with, 85.
Sexual selection, 194–197.
Sharp, Dallas Lore, 153.
Shrew. *See* Mouse, shrew.
Shrike, or butcher-bird (*Lanius* sp.), chasing a brown creeper, 288, 289; catching a junco, 289, 290; attacking a robin, 290, 291.
Skunk, 286.
Snakes, wintering, 285, 286.
Snowbird, *See* Junco.
Soldier, the, 7.
Soul, the physical basis of, 171.
Sparrow, bush, or field sparrow (*Spizella pusilla*), song of, 257, 258.
Sparrow, chipping (*Spizella passerina*), 150, 254.
Sparrow, song (*Melospiza melodia*), morning awakening, 43; repertoire, 43, 44; curiosity, 97; waning of song-impulse, 260.
Spencer, Herbert, 50; his philosophy purely scientific, 72.
Squirrel, gray, 46, 47, 96, 111, 112; grace of, 108; food of, 255.
Squirrel, red, 242; removing a store of butternuts, 45, 46, 84; winter life, 47; nervous manner, 95; mocking ways, 105, 106; jerkiness, 106, 107; his emotional tail, 108; vocal accomplishments, 108; playing tag, 108, 109; traits, 109; gathering butternuts, 110; spring food of, 143, 144; hoarding instinct automatic, 153; a tilt with a red-headed woodpecker, 251, 252; spring food, 254, 255; and weasel, 280.
Starfish, amputating its arm, 116.
Stars, the, 21–23.
Steeple-bush, 236.
Stoat, chasing hare, 280, 281. *See also* Weasel.
Streams, and gravitation, 87.
Sun, a type of Nature's spendthrift method, 80.
Suns, evolution of, 81.
Swallow, barn (*Hirundo erythrogastra*), and a pair of phœbes, 223; wing-power, 224–228; catching insects, 226–228; feeding young, 227, 231; young learning to fly, 228–230; notes, 229.
Sycamore, seed and birds, 254.

Teazel, 236, 237.
Telepathy, 197–199.
Tennyson, Alfred, Lord, and the physical sciences, 70.
Thorndike, Prof. Edward Lee, his experiments, 176; quoted, 187.
Thrasher, California (*Toxostoma redivivum*), 130.
Threshing, 93, 94.
Thrush, hermit (*Hylocichla gutata pallasi*), song of, 260.
Thrush, wood (*Hylocichla mustelina*), 151; nest-building, 267, 268; fate of two nests, 269 270.
Toads, 284.
Tree-frogs, 284.
Trees, intelligence of, 203, 204.
Tropisms, 169, 170.
Tyndall, John, 54.

Up and down, 218–220.

Valleys, 25.
Vireo, red-eyed (*Vireosylva olivacea*), song of, 259.
Vitalism, 55, 56.

War, the Civil, 7–10.
Warbler, mourning (*Oporornis philadelphia*), 44.
Wasp, solitary, 17, 205.
Water, the law of, 138.
Weasel, mysterious power over the rabbit, 274–281; pursuing chickens, 276; an experience with a weasel, 276; seizes its victim in flight, 277; chasing a chipmunk, 277; chasing a red squirrel, 280.
Weeds, fattening on our labor, 151.
Whip-poor-will (*Antrostomus vociferus*), song of, 259.
Whitman, Walt, quoted, 34, 58, 62, 71; and science, 71.
Wildcat, the killing instinct in, 152, 153.
Winter, wild life in, 281–288.
Woodchuck, edibility, 26, 27; food,

27; hibernation, 27, 28, 285; habits, 28; and farm-dog, 29; a race with a, 30, 31; winter stores of fat, 46; watchfulness, 94; hole, 246.
Woodchuck Lodge, life at, 24–47.
Woodpecker, downy (*Dryobates pubescens mediarus*), winter quarters, 155, 156, 188–190, 248–251.
Woodpecker, hairy (*Dryobates villosus*), 251.
Woodpecker, red-headed (*Melanerpes erythrocephalus*), chasing a red squirrel, 251, 252.
World, the, beauty and wonder of, 1, 2; and the other world, 14, 15; birth and growth, 16; conception of its sphericity, 217–221; its motion in space, 221.
Wren, house (*Troglodytes aëdon*), song of, 256.
Writing, object of, 5.

Yellow-jackets. *See* Hornets.
Youth, 11.

The Riverside Press
CAMBRIDGE . MASSACHUSETTS
U . S . A

CHRISTIAN HERITAGE COLLEGE LIBRARY
3071748